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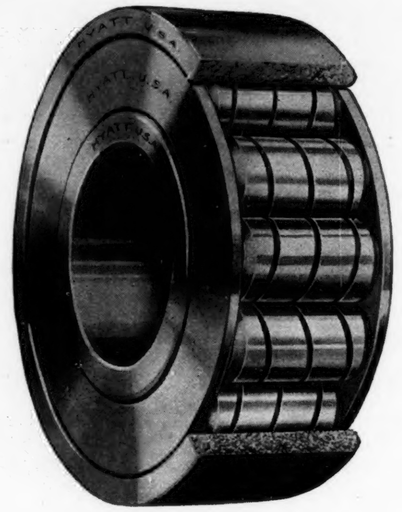

AGRICULTURAL ENGINEERING

The Journal of Engineering as Applied to Agriculture

Vol. 7 NOVEMBER, 1926 No. 11

Engineered Production the Main Requisite to Profitable Farming*

By Thomas D. Campbell

Mem. A.S.A.E. President, Campbell Farming Corporation

HAD any of the Pharaohs who lived several thousand years before the birth of Christ visited the United States one hundred years ago they would have found but little difference in the method of tilling the soil from what the Egytians used in the Nile valley when they were erecting their pyramids. Most of our development in the improvement of agricultural machinery has come within the last sixty years and the greater portion of that has been done by manufacturers in the United States.

It is not over one hundred years since ninety to ninety-five per cent of our people lived on farms and produced all their own requirements, including food and clothing. They consumed everything they produced and had nothing to sell. It was not until the development of our transportation systems, the opening of new country, and the growth of cities that the farmer began to produce a surplus—and this surplus has been one of his problems ever since, making it necessary for him to compete in other markets and because of this competition to reduce the cost of production.

This reduced cost of production has been made possible by the ingenuity and progressiveness of the American manufacturer of agricultural machinery and, as a result, the American farmer produces every food commodity with much fewer man-hours than any other country in the world.

The first great steps in this reduced cost of production were the invention of the binder and the cotton gin. Later came the improved types of threshing machines operated by horse power, then by steam, and later by the internal-combustion engine, until machines were produced which can thresh over four thousand bushels of wheat in fourteen hours. But real economy in harvesting and threshing was not attained until the invention of the combine. The combine had had to go through the universal opposition that every new machine encounters, but has finally proven its merit and it is my belief now that no farmer in the United States with 160 acres or more of land can afford to be without a combined harvester and thresher. The present combine at a reasonable cost is the most outstanding development in agricultural machinery that has ever been accomplished.

This short summary brings us to the present era and, while the development has been great, there has, with the exception of the combine and the internal-combustion engine, been but little change in the last twenty-five years. Other industries have increased their output per man many fold. Automatic machines have made it possible for one man to do the work of from five to thirty. Larger locomotives have made it possible for the same train crews to haul several times the number of cars they could move thirty years ago, but in a sense the farmer is still driving four horses.

A correspondingly increased output per man, however, has not been accomplished by the farmer because he has not had the chemical laboratories or mechanical departments to decrease his production costs and he has had to depend on the experimental work of the manufacturers of his machinery and on the Department of Agriculture. The manufacturers have attempted this in various ways, but have been reluctant to give the farmers the improvements the other industries got because of the experimental costs and, primarily, because the farmer did not demand it. Many of the machines, particularly internal-combustion engines, marketed by some of our best companies during the last twenty years have contributed largely toward the failure of our farmers. They have sold mechanical monstrosities which could not be operated by their own experts, much less by inexperienced farmers. They have urged farmers without any mechanical ability to buy equipment which requires adjustments in thousandths of an inch and the best evidence of the inefficiency of these

*An address before the 33rd annual convention of the National Association of Farm Equipment Manufacturers, at Chicago, October 21, 1926.

(Above) The old method of harvesting not only required five men for four binders but involved expense for twine, labor for shocking, and threshing by a costly method. (Below) The new windrow method takes only three, or sometimes two, men to a train of four machines and tractor. There is no twine, no shocking, and threshing is done by the vastly less costly combine method

"Our department of agriculture, our agricultural colleges, and our manufacturers can do a great deal towards solving the farmers' problems, but the greatest work will be done by the agricultural engineer. . . . . . . The big engineering opportunity before the college man today is agriculture and the greatest manufacturing opportunity in the United States today lies before the manufacturer of agricultural machinery."

machines is that their abandoned wrecks are scattered over the entire farming area of the United States. It was impossible for the most intelligent farmer to operate them successfully. This has done a great deal to prejudice many people against power farming, particularly country bankers, and the expression that "no tractor farmer can succeed" is quite common among the heads of rural banking institutions.

It is common practice for people to criticise. It is easy to find fault without being able to suggest remedies. I have read so many articles of late and have heard so many discussions in regard to what is wrong with the farmer that sometimes I cannot help but ask the question, "What is wrong with the rest of the people?" I know for certain that the fault is not all with the farmer. It occurs to me that our Department of Agriculture or agricultural colleges and our manufacturers can do a great deal towards solving the farmer's problems, but the greatest work will be done by the agricultural engineer. The Department of Agriculture for many years has done great things for our farmers, particularly along academic lines such as agronomy, planning, and the treatment of seeds. Very little attention, however, has been given to the practical or cost-production side of farming and that is one thing the farmer must do. When we have a surplus which we must sell in foreign competition we must do as all other manufacturers do, namely, reduce the cost of production. I am not in any way unmindful of the advantages of the Department of Agriculture and consider information we have gained from it one of the big factors in our success, but I do feel that the Department could issue pamphlets showing methods of reducing production costs to good advantage.

The manufacturers, however, can do even more by building better and stronger machines. Not one type of agricultural machine, except combines and some plows, come on our job which can satisfactorily stand tractor operation. This is not strange. Manufacturers for years have been producing equipment for horses to pull. As a result, they have endeavored to make it light and in all of their advertisements the words "easy-running", or "light-draft" have been emphasized. It is absurd to think that this equipment can be hitched to a moving tractor which pays no attention to dead furrows or other obstructions and stand up under the strain. Some of our most progressive manufacturers have been realizing this the past few years and have put experimental machines out for active field operation before being definitely placed on the market. I doubt if there is any statistician in the United States who could accurately estimate the loss in time and money to the farmers of the United States through improperly designed and fragile machinery; for instance, I do not know of a tractor on the market today that comes equipped with the proper width of tires. The best evidence of this is that the factory representative promptly recommends and is always willing to sell a pair of extension rims. Other organized industries would not tolerate such treatment. There is absolutely no plan of standardization among the manufacturers of agricultural machinery. Scientific tests can determine the proper diameter and proper width of tractor tires. Bicycle manufacturers finally adopted a twenty-eight inch wheel. Automobile makers have adopted practically a uniform size of wheel and tire, and railway car builders long ago adopted standardized diameters of wheels and standardized couplers.

I do not know of a binder made today which has a grain wheel large enough in diameter so that it can go over rough ground or through dead furrows at three miles an hour without ultimately collapsing. If the grain wheel had the same diameter as the bull wheel the binder would last much longer. I do not know of a binder today which has a diagonal brace with a turnbuckle or other adjustment extending from the sickle head end of the platform diagonally to the rear outside end. It is only recently that manufacturers of tractors have been willing to give force-feed lubrication through a hollow crankshaft, governors and other safety devices, and none as yet has given us a satisfactory spring mounting. Manufacturers of agricultural machinery built steam engines for years and up to the end I do not know of one manufacturer who furnished the farmer with even a balanced valve.

The cost of parts has been another obstacle in the success of power farming. There is no reason why the list of repair parts on agricultural machinery should be several times the cost that a local foundry, poorly equipped and with less volume, can sell them for at a profit.

Please do not think that I mean to criticise severely the manufacturers of agricultural machinery or that I have ill will towards them. The very reverse is the condition, as they have always been particularly good to us and have been big factors in the success of my family. Farmers would not have had any mechanical improvement at all had not the manufacturers been willing to spend their funds for the benefit of the farmer.

I earnestly believe that farming can succeed, but it means small farms operated by the farmer and his family with no pay roll or it means power and larger farms under scientific direction, industrial management, and the employment of skilled labor at high wages. It is almost impossible for any farmer to succeed on 160 acres of small grain land. The

(Above) Making a world's record of 4321 bushels of wheat in fourteen hours on the Campbell farms with a late model, all-steel thresher which has threshed over 750,000 bushels of wheat. This method is now obsolete in Mr. Campbell's practice. (Below) The Campbell standard wheat train which hauls an average of 2000 bushels at three miles an hour with a crew of two men. The hitch permits twelve wagons to make right angle turns on country roads

overhead per acre is too large. This is particularly true of semi-arid land in the Northwest. Any man who can operate 160 acres of land in the Northwest could easily get $150.00 per month at any kind of work in the city. This is $1,800.00 per year, or about $11.50 per acre overhead. The net average profit on such an acre with the lowest cost of production will average from $2.00 to $2.50 per acre, giving a net profit of from $320.00 to $400.00. This shows that it is economically impossible for a man to succeed on the regular homestead farm in the semi-arid regions. A two-thousand-acre farm is the minimum, and with modern machinery such a farm can be operated by a few skilled men. The same is almost true of 160 acres of corn land in any of our older states. All quarter-section farms should be consolidated into sections of land or into some other unit of economical operation, comparable to eighty-ton furnaces, thousand-barrel cement plants, thousand-barrel flour mills, etc. All other industries have by experience and records proven economical operating units, but the farming industry to date has not even given this a thought. This is a point which could be well worked on by the Department of Agriculture.

There are, admittedly, many obstacles in farming, such as weather hazards, insect pests and variable markets, but the biggest obstacle the farmer has to overcome today is the universal belief expressed by our bankers, railway presidents, industrial heads, politicians, economists, Secretary of Agriculture and even our good President that farming cannot succeed. I predict that the time will come within twenty years when farming will be industrialized, when it will have the prestige and dignity to which it is entitled and when it will attract and hold the country boy with brains, who is now in town directing ninety per cent of our industrial development. I doubt if there is a man in this room directing the affairs of the large institutions which you represent who was not raised on a farm. This success will bring independence to the farmer and will hasten cooperative marketing. It will make it possible for him to market his grain as and when he thinks fit without doing it under the direction of some mortgagee. Our cooperative marketing associations so far have failed primarily because seventy-five per cent of the wheat was mortgaged and the independent farmers have not joined.

The greatest work, however, will be accomplished by the agricultural engineer and the manufacturer. The big engineering opportunity before the college man today is agriculture and the greatest manufacturing opportunity in the United States today lies before the manufacturer of agricultural machinery. I do not believe that there is a manufacturer of agricultural machinery in the United States who will be able to supply within the next ten years the universal demand for a good tractor with the equipment which it will pull and the demand for combines. There is eighty-six million horsepower to be displaced on the farm and this, with the equipment which has to be supplied to fill the new demand for stronger machinery, results in a volume so large that it is almost impossible even to estimate. Two thousand million dollars would be very conservative. Add to this the greater demand from foreign countries and the volume cannot be estimated.

I have been hearing of the saturation point in automobiles and trucks for many years, but I assure you that the saturation point in power machinery for agricultural purposes is infinitely further away. Next to farming, which I consider the greatest business in the world, I would rather be a manufacturer of agricultural machinery. You have put the American farmer far in advance of any other farmer in the world. You have made it possible for us to plow at a labor cost of thirty cents per acre, disc for ten cents, seed for eight cents, and harvest and thresh for twenty-five cents. You have made it possible for the farmer's wife to be relieved of many burdens, you have given him more comforts than he realizes, and you should have his universal gratitude.

(EDITOR'S NOTE: Mr. Campbell is scheduled to address the Farm Power and Machinery Division of the A.S.A.E. on the morning of December 2, at the division meeting in Chicago. It is expected that he will then go into intimate technical detail as to power farming and other machinery design, with especial reference to conditions and requirements of super-farming, as brought to light in his operation of a 100,000-acre wheat farm.)

Strength Tests of Threaded Pipe Joints

By J. Grant Dent

Assoc. Mem. A.S.A.E. Instructor in Mechanical Training, University of Minnesota

WITH a view to determining the tensile strength of pipe, and particularly threaded pipe joints, in connection with the use of pipe for supporting tanks, balconies, etc., and for such uses as pump rods, the author made a series of tests in the laboratory of the division of agricultural engineering, University of Minnesota, using a Raleigh testing machine.

In applications of this sort, where it is not necessary that the joints be tight against fluids, the threaded joints may not be screwed home due to the use of the pipe thread as a means of securing a length adjustment; also, in this class of work both pipe and fittings may be threaded so inaccurately so as to prevent engagement of a normal number of turns. Consequently, the tests covered joints with engagements of one, two, and three threads, respectively, as well as joints turned up tight and engaging approximately seven threads.

An interesting and, in cases where the element of safety is involved, an important point brought to light was the fact that some pipe is defective, in that it seems to be made up of at least two concentric layers with only a comparatively weak bond between them. In such cases the outer layer, when cut nearly or entirely through, in the process of threading, slides off the underlying layers when the joint is subjected to tension.

Breaking Strength of Pipe Threads

Standard ¾-inch black pipe. Standard amount of thread (½-inch plus one thread). Malleable couplings. Raleigh testing machine.

	No. threads pipe was turned into coupling	Strength pounds	Manner of failure
1.	One	2980	Stripped thread
2.	"	5180	" "
3.	"	4250	" "
4.	"	4280	" "
5.	"	5870	" "
6.	"	5420	" "
7.	"	3800	" "
8.	"	4940	" "
9.	"	1940[1]	" "
10.	"	4250	" "
		Average of 10 tests, 4291 pounds	
1	Two	6520	Stripped threads
2.	"	6450	" "
3.	"	7210	" "
4.	"	6470	" "
5.	"	8050	" "
6.	"	8340	" "
7.	"	7900	" "
8.	"	7850	" "
9.	"	6490	" "
10.	"	8330	" "
		Average of 10 tests, 7361 pounds	
	Three	12,200	Pipe failed[2]
	"	9,140	Stripped threads
	"	10,200	" "
	"	9,640	" "
	"	11,130	Pipe failed
	"	13,980	" "
	"	11,510	" "
	"	11,220	Stripped threads
	"	11,200	Pipe failed
	"	12,200	" "
		Average of ten tests, 11,242 pounds	
	Seven or all	14,360	Pipe failed[3]
	"	14,810	" "
	"	17,000	" "
	"	14,490	" "
	"	13,370	" "
	"	15,780	" "
	"	14,770	" "
	"	14,210	" "
	"	16,700	" "
	"	16,090	" "
		Average of ten tests, 15,158 pounds	

[1]Defective pipe, outside layer carrying thread pulled off.
[2]Pipe broke in thread at edge of coupling.
[3]Pipe broke in thread at edge of coupling.

NOTE: Tensile strength of samples of ¾-inch standard black pipe used: 18,600, 17,200, and 17,500 pounds; average of three tests, 17,783 pounds.

(EDITOR'S NOTE: Examination of the variations in the strength of specimens within each class of joint suggests points for further investigation. With an engagement of

only one thread the minimum breaking strength is shown as only 50 per cent of the maximum; with two threads the minimum was 77 per cent of the maximum; for three threads, 65 per cent; while for joints screwed up tight the ratio was 78 per cent. Although the intermediate figures are inconsistent, it is plain that variations in strength are much greater for a very short thread engagement than for a normal tight joint. This raises the question as to whether the clearance between internal and external threads, and hence the depth of engagement, may not have as much or more influence on the strength of the joint as the number of threads engaged. This point assumes practical importance when we consider cases in which only a few threads are engaged due to the joints coming tight because of oversize external or undersize internal threads, before a normal number of turns into the fitting have been made. In all cases where failure occurs by stripping the thread, it would appear that depth of thread engagement should have at least as much influence on the strength of the joint as the number of threads engaged.

It is interesting to note further that for joints turned up tight the average strength is 85 per cent of the average strength of the pipe used.)

Durability of Rammed Earth Walls

By T. A. H. Miller

Associate Agricultural Engineer, Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture

A GROUP of plantation buildings and an attractive Gothic church located near Sumter, South Carolina, which were constructed of pise de terre, or rammed earth, recently was inspected by the writer. The farm buildings were built about 1820 and the church was completed in 1852. This inspection furnished convincing evidence that rammed earth walls are durable and are suitable for a variety of farm structures. Besides withstanding the ordinary elements for a hundred years or more, these structures survived the Charleston earthquake in 1886, a three day hurricane in 1895 and a cyclone in 1903. The average annual rainfall in this locality is 45 inches and the average temperature is 64.5° F. The average January temperature is 45.9° but a minimum temperature of 3° is recorded.

The farm structures, seven in all, are on Hill Crest Plantation, the home of W. L. Saunders. The central portion of the dwelling (Fig. 1) is a frame structure, while the wings are of rammed earth, the frame portion having been covered with stucco to match that of the rammed earth walls. The lower-story walls of the servants' quarters are of earth and the second story of frame construction. Plaster was applied directly to the interior surfaces of the earth walls of this and other buildings.

The plan (Fig. 2) gives the principal dimensions of the church, which has gable walls 40 feet high. Fig. 3 shows the exterior from the northwest, and Fig. 4 the pleasing interior. The foundation is of brick laid in lime mortar on flagstone footings as shown in the cross-section (Fig. 2). The buttresses, chimneys and window piers also are of brick masonry. Apparently the bricks were not of first-class, hard-burned type since many have disintegrated while the earth walls have remained intact. The floor is of concrete laid in an earth fill. The interior walls are plastered over furring. There is no sign of there having been moisture or condensation on either the walls or floor. The roof originally was covered with wooden shingles but these were replaced, in 1916, by red-colored, pressed-cement tile.

Fig. 5 shows one of a number of large cracks in the church walls caused by the earthquake but which have apparently not weakened the structure. However, cracks in the stucco or around window sills, etc., may be indications of conditions which will cause serious trouble. The original church tower was thrown down during the cyclone of 1903. This was due, according to the residents, to a large crack between the tower and the main building caused by the earthquake and allowed to remain insufficiently protected from the rain for 17 years. The damage to the stucco coating and to the wall below the chancel window (Fig. 6) probably was caused by water finding its way through a crack in the window sill. The flashing shown was not used originally but indicates that someone anticipated trouble at this point.

The earth used in these structures is a red sandy clay loam obtained nearby. It contains few, if any, pebbles but some small roots and grass such as commonly is found in soil lying near the surface. It is evident that this vegetation was not used as a binder because of its irregular distribution, being entirely absent from portions of the walls.

Although exposed to the weather for years the earth has not softened but can be "dusted" rather freely. However, this seems to be a characteristic of the material because the surface could be "dusted" after several inches of the outer wall had been picked away. Incidentally, the fact that picking is hard work is evidenced by the pick marks showing in Fig. 6.

The resistance of rammed earth to water splashing against it is surprising. Several of the buildings on the plantation have stood for a number of years with leaky roofs and water, pouring over the walls, did not destroy them although causing such serious damage that two of the buildings had to be wrecked. A section of a garden wall of earth has stood for fifty years unprotected, yet it is so hard that a nail can be driven into it only with difficulty.

Lime stucco has been used on all the structures and has proven very satisfactory and durable. It probably was made and applied in accordance with directions for rough cast given in Johnson's "Rural Economy." It varies in thickness from ⅛-inch to ¾-inch. The original color was dull red. Later this was covered with whitewash, and recently with a cream-tinted "Stone Tex" which is peeling off very much as does zinc paint. This probably is due to the fact that it was applied to a whitewashed surface, thus preventing a good bond. The various coatings can be observed in Fig. 5. The dull gray color is the "Stone Tex," the light blotches the whitewash; the darker spots below the whitewash show the original stucco and the darkest blotches the earth wall.

The lime stucco has a soft, warm appearance and apparently does not crack as does portland cement stucco. It seems to wear thin as though from abrasion and wherever patches have fallen off there are signs of cracks in the earth

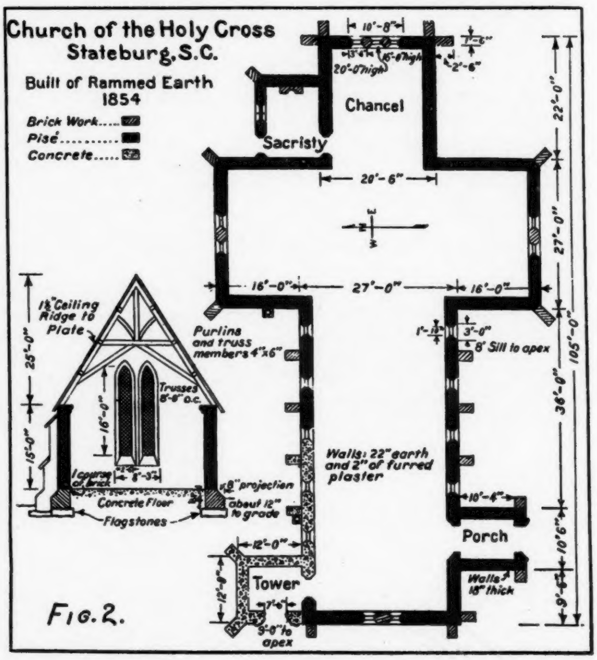

Fig. 2.

beneath or of a faulty detail. An example of its durability when exposed to splashing water is shown in Fig. 7. Here the stucco is unprotected yet is in almost perfect condition after 106 years.

Fig. 8, showing the plantation library, illustrates a type of architecture that affords good protection to the walls. The stucco on this building is troweled smooth and laid off as ashlar and is in good condition. A crack occurs at each corner and such cracks were observed in the walls of other buildings, (Fig. 7), suggesting the advisability of reinforcement or quoins at such points.

There is no evidence of rats having attacked the earth walls but "mud daubers" have nested freely in the exposed earth of two buildings (Fig. 9). It is of interest to note that their attacks started only five years ago, according to Mr. Saunders, and also that apparently the daubers do not bore through the lime stucco.

The question as to how rammed earth came to be employed in this vicinity is of interest. Evidence points to the fact that Dr. W. W. Anderson, who constructed the buildings described, probably was acquainted with S. W. Johnson, the author of "Rural Economy" which contains directions for the construction of rammed earth walls. At any rate, a copy of Mr. Johnson's book is in the family library.

It is difficult to understand why rammed earth has not been employed in this country more generally. It is as durable as adobe and has a wider range of application under suitable climatic conditions. The construction of rammed earth walls seems to be primarily a home art, best practiced in regions having a suitable climate and the proper kind of earth. Special consideration needs to be given to the development of proper foundations, and structures should be of such design as will afford protection to the stucco.

Fig. 1. The W. L. Saunders dwelling house, the wings of which are of pise de terre, or rammed earth, built in 1820. Fig. 3. Church of the Holy Cross, Stateburg, S. C. Constructed mainly of rammed earth. Fig. 4. Chancel of the Church of the Holy Cross. Fig. 5. Crack in church wall caused by earthquake. Fig. 6. Damage to wall and stucco from entrance of water. Fig. 7. Loom house built about 1820. Fig. 8. The Saunders plantation library, also built about 1820. Fig. 9. Section of tool house wall built in 1820, showing work of mud daubers during last five years

Electrically Heated Chick Brooders*

By Geo. W. Kable

Mem. A.S.A.E. Agricultural Engineer, Oregon Agricultural Experiment Station

TESTS have been conducted by the Oregon agricultural experiment station to determine the characteristics and merits of electric brooders, commercial and otherwise, now in use; to investigate the merits of various ways of providing heat and ventilation; and to study the possibilities of improving on present practice.

For the laboratory work a special floor, with a glass panel in its center, was built at a height convenient for observations from above and below. Horizontal distribution of temperature was studied by thermometers placed in wire racks at a standard chick height of 2½ inches, and vertical temperature ranges by thermometers arranged in racks with steps one inch apart. Air movements were observed by noting the behavior of smoke from incense burned under and around the hovers, and an anemometer was used for measuring air velocities. A graphic wattmeter recorded the frequency and duration of circuit closure by the thermostats, and the total power consumed was measured by a watt-hour meter.

In Table I the brooders tested are classified as to type by numbers indicating the methods of heating, as follows: (1) Direct radiation, non-glowing; (2) direct radiation, glowing; (3) direct-indirect; (4) indirect. The manner of ventilation is indicated by letters, namely, (A) in at edge and out top vent; (B) up through floor and out at edge; (C) cross ventilation; (D) mechanical.

The outstanding feature of the Lamb brooder shown in Fig. 2 is the rather steep gable roof, which was expected to aid materially in ventilation. Contrary to expectations, it was found that a large volume of smoke released under the hover spread out at the level of the lowest heating wire, apparently was dispersed by radiation and reflection from the sheet iron lining of the top, and for the most part came out under the edge of the hover, with only a small amount emerging from the vents. Below the edge of the hover the air remained clear. No material difference was made by half closing the vent. When slitted canvas curtains reaching nearly to the floor were attached to the edge of the brooder a much larger proportion of the smoke passed out at the vents. When two-inch vent tubes extending downward through the holes in the top to within 4⅜ inches of the floor were inserted the smoke rose to the top of the brooder, filling it down to the level of the bottom of the vent tubes. Below this the air remained clear and no smoke escaped at the edges.

An important point in connection with the satisfaction to be secured in the use of electric brooders was brought out in connection with brooder No. 2 shown in Fig. 3. In this case the manufacturer's instructions specified that the thermostat was to be set to hold a temperature of 100 degrees Fahrenheit, but the placing of the brooder thermometer was such that it indicated 117 degrees when the temperature at chick height was 95 degrees. Field investigations lead to the belief that discrepancies of this sort have resulted in condemnation of electric brooding in cases where the method was not inherently at fault.

It was found that smoke liberated under this hover spread out under the flat roof and that more of it escaped through the vent than was the case with the gable roof construction. Smoke placed directly under a heating coil was spread out by the radiated heat and when placed between the coils the movement was sidewise and out under the edge of the hover, which for this test had the curtains rolled up three and one-half inches from the floor.

Brooder No. 3 differed from No. 2 only in having the heating coils supported by hollowed out wooden strips so that direct radiation downward was shut off by the strips. Air movement within it, as shown by smoke, was exactly similar to that in No. 2. If the curtain was raised at any point smoke would be drawn that way and escape. With the curtain pinned up all around smoke was deflected inward until it reached the top, where it turned and escaped rapidly out at the nearest edge. When this brooder was placed on a slatted floor covered with one thickness of burlap, no change in the behavior of smoke was observed, it not being drawn toward or under the permeable floor at any point.

The distinctive features of brooder No. 4, Fig. 4, are its conical shape and an inner heated area 35 inches in diameter, with its own curtain, and an outer, unheated zone, 55 inches in diameter, surrounding the inner part. The heating wires are arranged near the outside of the inner part. A central

*Abstract of a paper presented at the twentieth annual meeting of the A.S.A.E., Lake Tahoe, California, June, 1926. This paper will be printed in full in the 1926 Transactions of the Society.

TABLE No. 1.
DESCRIPTIONS OF BROODERS – O.A.C. LABORATORY STUDIES

Brooder No.	Make	Type	Cost	Size In.	Mfgr's Rating No. Chicks	Sq. In. per Chick	Material	Heat Elem. above Floor In.	Size Wire B&S Gage	Kind of Heating Elements
1	Lamb (Home made)	1A	$16.00	28×95	500	5.37	Wood & Galv. Iron	6½-9¼	#22	Straight wires on knobs
2	Master (Old Type)	1A	$25.00	32×70	500	4.48	Wood	5½	#22	Coils on Wood Sticks
3	Master (New Type)	3A	$25.00	32×70	500	4.48	Wood	5½	#17	Coils in Wood Troughs
4	Lyon	1A	$35.00	55 diam 35 diam	350	6.75	Galv. iron and wood	8½	#22	2 coils on cleats
5	Mailwin	1A	$32.00	54 diam	500	4.54	Galv. iron	8	#21	1 coil on knobs
6	Improvised	1B	—	"	"	"	"	"	"	" "
7	"	1&3B	—	"	"	"	"	"	"	" "
8	McNett (Home made)	3D	—	48" diam	500	3.62	Galv. iron	10-18	#22	Coils on knobs
9	"	"	—	48×48	500	4.64	Wood	16	#22	" " "

TABLE No. 2
LABORATORY STUDIES OF BROODERS – O.A.C. 1926

Brooder No.	Brooder Make	Brooder Plan – Elev.	Test Rating Watts	Temp. Resistance Wires °F.	Time to Bring to Brooding Temp. 95°	Temp. Variation °F. 2½ in. above Floor	Temp. Variation °F. Brooder Thermometer	Temp. Variation °F. * Vertical	Air Changes per Hour† Vents Open Full	Air Changes per Hour† Vents Open ½	Temp. of Escaping Air	Current Breaks per Hour	Remarks
1	Lamb (Gable Roof)		840	385	From 63° 2 hr. 17 m.	94-96	—	—	114		174	40	No curtains
1-A	Same		840	385	From 68° 56 m.	95-96.5	—	95-112	92		92.8	35	Curtains and Vent Tubes
2	Master (Old Type)		740	180	From 62.5° 1 hr. 15 m.	92-95.5	117	97-130	174	144	125 est.	22	
3	Master (New Type)		580	146	From 68° 1 hr. 0 m.	92.5-97	119	92-120	204†		118 est.	13	
4	Lyon		480	325	From 64.4° 30 m.	C. 95-99 Outer 84	103	94.4-102.2	58	38	97 est.	26	
5	Mailwin		1120	610	From 72.5° Under 10 m.	95-97.5	109	96.5-102.2	39		96.8	152	
6	Improvised		1120	—	From 60° 17 m.	94-95.6	109	95-104	Too slight to measure				With 5"×7" vent tube 4" above floor
7	Improvised		1660	—	—	95-108	115	—	66		482*	34	With 6"×5" vent tube containing 540 w. heating element
7A	Improvised		540	—	—	88.5-91.6	102	—	56		482*		As above with brooder heat off
7B	Improvised		540	—	—	96-98.5	100	80.6-103.1	146		162*		6"×21" tube with 540 w. radiant heater element

*From ½" above floor to 5" above floor. † Approximate. * Temp. of entering air.

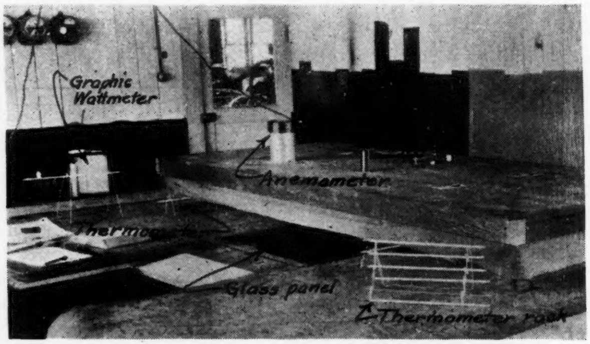

Fig. 1. New type Master brooder on the testing floor. Features of apparatus and installation also are shown

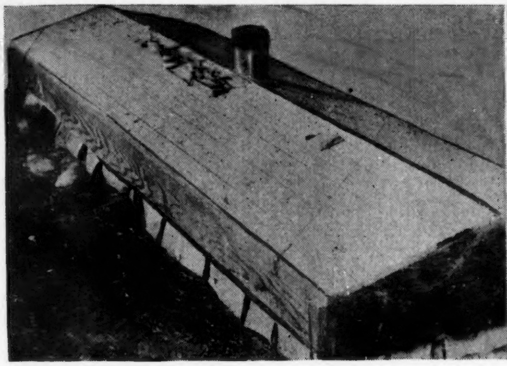
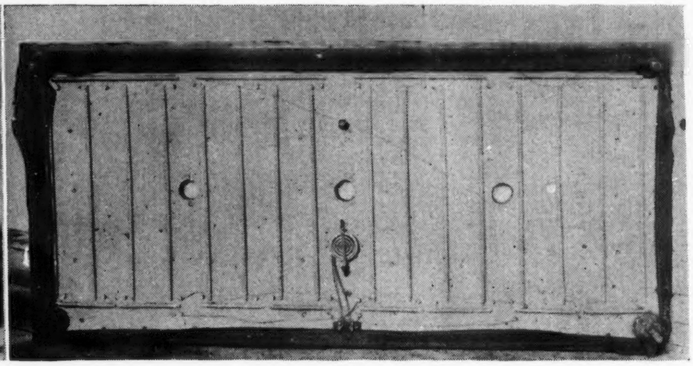

Fig. 2. (Left) The Lamb brooder, a farmer's design and construction. Fig. 3. (Right) Underside of the old type Master brooder

vent tube extending to within 6¼ inches of the floor is employed, and it was found that smoke placed between the inner and outer curtain had slightly more tendency to pass inward under the inner curtain and out the vent than to escape through the outer curtain.

Brooder No. 5 is in the form of an octagonal pyramid, with an inner top, flat, joining the outer one 8 inches from the edge, at which point the single coil of heating wire is supported by knobs. The material is sheet steel, so that the outer part of this brooder has very little heat insulation, and the thermostat being located within 2½ inches of the outer edge is exposed to rapid heat losses. Its ventilating provisions and the behavior of air currents were similar to those previously described. The exposed location of the thermostat resulted in a cycle of operation being completed every twenty-four seconds, a frequency which it is believed invites unnecessary trouble with contact points.

In test No. 6 the foregoing brooder was used, so modified as to introduce a new principle in brooder ventilation. The top vent was closed and a special ventilating tube five inches in diameter and seven inches long, extending four inches upward through the floor in the center of the brooder, was installed. As intended, the direction of movement was upward through the central tube and outward under the curtain, but the velocity of movement was extremely sluggish, apparently being slower than any other arrangement tested.

In test No. 7, Fig. 7, a similar tube of slightly different proportions was used with a 540-watt radiant heating element inside it. Naturally this amount of heat added to the regular overhead radiation of the brooder was considerably in excess of requirements. While there was slightly more circulation upward through the heated tube than through the unheated tube used in test No. 6 it was much less than might be expected. Test No. 7-A differed from No. 7 only in not using the regular overhead coils of the brooder. The amount of heat supplied was hardly adequate at a room temperature of 60 degrees. The important point, however, was that the air movement under the hover was the same as before, namely, a sluggish movement up through the heated ventilator tube and outward under the hedges of the hover. Due, of course, to the amount of heat being carried by so sluggish a stream of air, the air emerging from the tube and spreading out under the hover was, at the top of the tube, at a temperature of 480 degrees Fahrenheit, resulting in uneven distribution under the hover and involving a considerable fire hazard.

At this point it seemed worth while to attempt to increase the thermosiphonic or chimney action by employing a longer column of heated air. Using the same heating element and brooder and a tube 6 inches in diameter and 20 inches long, below the floor, with the heater at the bottom, a brooding temperature throughout the 4½-foot hover was attained with

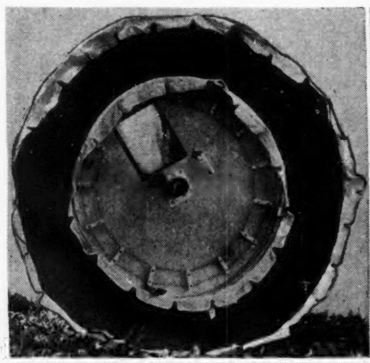
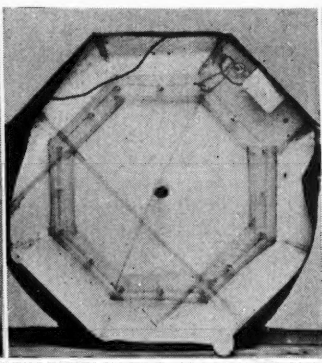
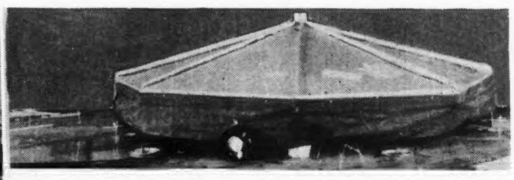

Fig. 4. (Left) The Lyon brooder as seen from below. Fig. 5. (Middle) Lower side of the Mailwin brooder. Fig. 6. (Right) Mailwin brooder under test, showing smoke pans, anemometer, and thermometers

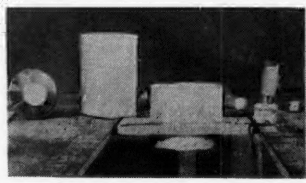
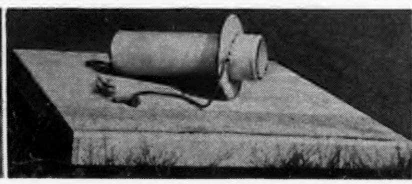
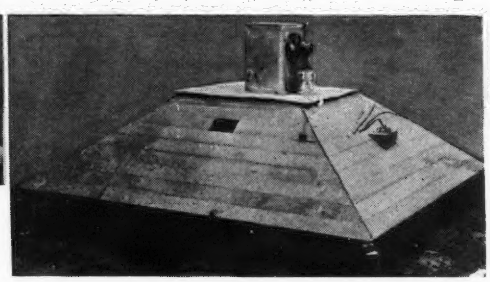

Fig. 7. (Left) Draft tubes and heating element used in tests Nos. 6 and 7. Fig. 8. (Middle) Fresh-air brooder devised as a result of the studies reported. The heating unit is lying on top of the homemade hover. Fig. 9. (Right) The original forced-draft brooder devised and built by F. McNett

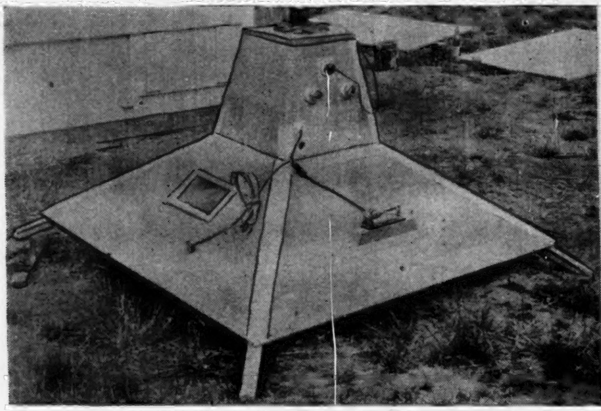
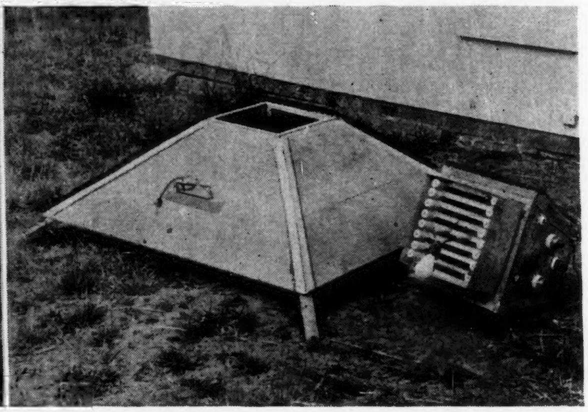

Fig. 10. (Left) A brooder of the McNett type designed and built in connection with the studies reported. Fig. 11. (Right) The same brooder with top removed from hover to show arrangement of heating coils and brood lamp

a variation of only 2½ degrees from the center to outer edges (test 7-B). This principle was further developed in the brooder shown in Fig. 8, in which the heating unit consisted of a double-wall galvanized steel tube 22 inches long, with a collar four inches from the top to support it in an 8-inch hole in the brooder house floor. This extended downward into a 30-gallon keg set in a hole under the floor. It was provided with a radiant heater element of larger capacity, obtained with some difficulty, and surmounted by a hover made of a double layer of one-inch boards separated by paper and covered underneath with asbestos paper. Provided with an ether wafer thermostat it operated very satisfactorily and a brood of three hundred and fifty chicks was reared under it with sufficient success to arouse the favor of poultry husbandmen.

The final type studied involved forced ventilation. Fig. 9 shows the original brooder of this sort, designed and used by a farmer, F. McNett. In this design a small fan at the top forces air downward through the heating element and over the chicks. It is of interest because of the possibility it seemed to offer of eliminating the so-called sweating of the chicks. In building test brooders of this type difficulty was encountered in securing an even distribution of heat and air throughout the hover, even though various arrangements of clear space and baffles were employed, as long as the fans were placed on the side of the top, consequently the design was modified to place the fans on the very top with their axes vertical, and in this way a reasonably good distribution of heat and air currents was secured. As finally worked out for practical use, Figs. 10 and 11, the heating elements were in two circuits, one of which was energized at all times that the fan was in operation, while the other was in series with a thermostat to afford temperature regulation. Although working out reasonably well in practice, the difficulty in this design of brooder is to keep the temperature near enough uniform to prevent the chicks from shifting.

To determine the effect of curtains and vent tubes on power consumption and ventilation, brooder No. 1 was tested with and without curtains and vent tubes. When the curtains were removed the cross ventilation beneath the hover was greatly improved, with a corresponding loss in heat, the power consumption being roughly doubled. With chicks under the hovers and curtains on both machines, the power consumption was greater for the brooder having vent tubes, indicating that the rate of air change and its attendant heat loss were greater than where tubes extending down inside the hover were not used.

In tests with the Master brooder to determine the effect on vertical heat distribution of raising the brooder, as many poultrymen do as the chicks increase in size, it was found that with no change in the thermostat setting, the effect of raising the brooder is to lower the temperature at all observation points from one-fourth to five inches above the floor. However, there seems to be no simple or consistent relation between the amount of elevation and the temperature changes. The outstanding effect is a relatively greater excess of temperature at the one-quarter-inch level as compared with other strata in the zone of observation. At lifts of both 1⅝ and 3¼ inches the temperature at ¼ inch from the floor is higher than at 5 inches or any intervening height.

As to the uniformity of temperature control by the thermostatic arrangement on the various brooders, it was found that at chick height the temperature variation ranged from 3½ degrees down to an amount too small for observation, and it was observed that the 3½-degree variation was due to the ether wafer being enclosed in a galvanized iron box for protection, and that when this enclosure was removed the temperature variation was reduced to one-half degree.

In connection with the tendency of manufacturers to simplify the design of heating element by getting away from numerous coils or strands under the entire hover and employ only one or two coils of heavier wire around the edge, the tests indicate that such change is justified from the standpoint of heat distribution and ventilation, and is advantageous with respect to durability and freedom from trouble.

At the beginning of these tests it was expected that, due to their being so close to the floor, the ventilation under electric brooders was poor, and that this poor ventilation played a material part in the so-called sweating of chicks. But the observations indicate that none of the brooders tested had less than thirty-nine changes or dilutions of air per hour, ranging from this figure up to two hundred and four. Moreover, the cross ventilation under the curtains of most brooders is estimated to exceed that measured at the vents. Slatted floors covered with burlap do not affect the ventilation but do reduce the sweating. It further is known that sweating occurs less in warm weather, that California results show it to be reduced by heating the brooder house floor, that there is less trouble of this kind under hovers heated by coal and oil stoves, and electric hovers of the radiant heater type. It therefore is concluded that the so-called sweating is not controlled so much by ventilation as it is by the temperature of the floor and of the lower part of the chick's body. It is pointed out that sweating is not perspiration but the condensation of moisture in the air, derived from the exhalations and droppings of the chicks. It seems that the problem is essentially one of dew-point, with the under side of the chick to be regarded as a condensing surface.

In the actual brooding tests of several electrically heated brooders operating in comparison with a coal-burning hover, it was found that the growth of chicks was practically identical, but the mortality was higher with the electric brooders, due not to any inherent defects but in part to failures of the current supply and also to low temperature due to improper placing of the brooder thermometer as mentioned above. This higher mortality contributed to the higher heating cost for the surviving chicks brooded electrically, the energy cost per chick for five weeks being 2.16 cents at 5.5 cents per kilowatt-hour, whereas the fuel cost for chicks brooded with coal was 1.2 cents.

Engineering Development in Agriculture

By O. W. Sjogren

President, American Society of Agricultural Engineers

THERE always has existed, and always will exist, a close relation and interdependence between agriculture and engineering. "Agriculture is the industry engaged in the production of raw material for food, shelter and clothing to fill the needs of the human race." "Engineering is the art and science of organizing and directing men and controlling the forces and materials of nature for the benefit of the human race." In other words, engineering deals with labor, power and materials. In agriculture, the production of raw materials for food, shelter and clothing, requires the use of equipment, of labor and of power. In the beginning of agriculture, labor and power were synonomous, both being supplied by man, or rather by woman under the direction of man. As man grew in intellect and advanced in civilization be began to learn how he might make use of the forces in nature, abounding on every hand, and he began to organize them and to direct them, resulting in the need of equipment. Such equipment was very crude at first, it is true, but it was the forerunner of the modern equipment of our day.

The first of our industrial developments dates back to the harnessing of power by James Watt when he invented the steam engine. This invention made power available to man, in larger amounts and of a different nature than had before been available. It marked the beginning of a new age, the age of machinery in which we now live. This invention coupled with the work of developing the plow by such men as Newbold, Jefferson, Wood, Webster, Lowe, Deere, Oliver and others, and the development of the reaper and harvester by such men as McCormick, Hussey, Deering, Whiteley, Marsh, Appleby, Gannon, Bushnell, Warder, Osborne and others could not have gone forward and been carried to the present stage of development without the work of Kelley and Bessemer in developing methods of simplifying and cheapening the processes of making iron and steel.

Engineering in Agriculture. We thus see the extent and importance of engineering. It has led to the problem of organizing and directing men to produce more efficiently the equipment with which agriculture can produce raw material for food, shelter and clothing to fill the needs of the human race.

It is a long way from the crooked stick and sickle to the modern steel plow and combined harvester-thresher of today. The following statement by J. B. Davidson aptly presents the situation: **"The most significant feature of the progress of American agriculture during the past century has been the introduction of machine methods of production, not only on account of the greatly increased production of each farm worker, but also by reason of the income available from the increased production. It is only by making a comparison of production by hand implements and with modern machine methods that the change in the effectiveness of farm labor can be fully appreciated. A careful study of agricultural production would indicate that for the principal crops the quantity of products is almost five times as great per unit of labor as it was before the general introduction of machinery. The effect on the farmer and the conditions which surround him are even of greater significance; much of the arduous toil of the farm is gone. The leisure time of the farmer is increased; his mental activity is stimulated; his home comforts are made possible and the desire for them developed."

Since 1840 the percentage of farm workers based on the total population, has decreased more than 50 per cent. With an increase in population of more than six times during this period the number of agricultural workers increased less than three times. The area in farms increased four and one-half times during this period while the value of these farms increased almost twenty times. In the decade between 1910 and 1920 there was a decrease in agricultural workers of more than 13 per cent and yet we had an increase of more than 100 per cent in value of crops produced per worker. That the operating equipment involving engineering in its design and manufacture has had a great influence in making possible this remarkable development is shown by the fact that, in 1870, $8.80 worth of implements were used for each farm worker producing $331.00 worth of crops. In 1920 each agricultural worker used $44.19 worth of implements in producing $1719.00 worth of crops. These figures indicate that the value of the product produced by each worker has increased more than five times in the space of fifty years, and is in almost direct proportion to the increase in value of the equipment used.

From data contained in U.S.D.A. Bulletin No. 1340 it is found in studying the relation of machinery to crop production that the average value of machinery per worker in the state having the lowest production per worker is $69.00 with $475.00 worth of crops produced. In the state having the highest value of crops produced per worker, $963.00 worth of machinery produces $1786.00 worth of crops. The data show conclusively that the value of crops produced tends to increase as the value of machinery used increased within reasonable limits. It is also further shown that the crop value produced per worker increases in proportion to the amount of power which he uses. When we stop to consider that from 40 to 80 per cent of the cost of producing our crops is involved in labor and power we can readily see why machinery has such a great influence on production. By the aid of machinery we are able to reduce not only the labor but the amount of high priced power required and substitute therefor low priced power. It is said that present day application of engineering has increased the production per man thirty-five times over what it was when hand methods were used.

The bulletin just mentioned has the following to say with reference to the future use of power on farms: "Present available information would indicate that power equipment is utilized to replace human labor in but little over one-half of the work now done on farms. Power equipment is available for a considerable part of the remaining work but for various reasons it is not now utilized." This indicates that in spite of the great development which has taken place with the introduction of modern farm machinery, there are yet unlimited opportunities for development in the adaptation of modern operating equipment to agricultural production—truly an engineering task.

The problem of harvesting our grain crops has made rapid strides in the past few years. When we stop to consider, however, that only 45 per cent of our crop acreage is devoted to grain, and that 55 per cent is in row crops for which no mechanical harvesting device has yet been generally adopted, we find that there is a very important problem yet confronting us in developing and adopting harvesting equipment for 55 per cent of our crop acreage. Certainly this calls for engineering knowledge and application.

The development in the past has been largely the result of individual effort on the part of each manufacturer. In the working out of his ideas very little, if any, basic information has been available relative to the fundamental principles upon which the machines operate. It has been largely a use of cut-and-try methods. While the development in the past has been largely individual, future development will show evidence of a pooling of brains and a cooperation of various agencies. An excellent example of the pooling of interests in the attempt to solve a very serious problem is exemplified in the present work in the matter of corn borer control. The entomologists through their study of the insect have traced out its life history and its nature and have found that the methods successfully used in the control of ordinary insects are useless

*From an address before the 33rd annual convention of the National Association of Farm Equipment Manufacturers, at Chicago, October 21, 1926.

**Bulletin 1925, No. 4, Part III. Bureau of Education, U. S. Department of the Interior.

in the control of this pest. The agronomists have tried various methods of control by means of tillage and crop rotation. They have found that the control is largely a mechanical problem, the solution of which involves the engineer. The agricultural engineer has come forward and designed machines and methods which will do effective work in the control of this serious pest, and the manufacturer is now being called upon to build the equipment. This is merely one example of the cooperation and working together which will be necessary more and more as time goes on. Suggestions for improvements will be secured from many sources such as individuals, trade associations, technical societies, research laboratories, etc. Future development will be largely a greater application of good engineering.

Reduce Cost of Production. We have heard a great deal within the past two years about the limiting of agricultural production as a stimulus to increase prices and increase profits to the producer. In all these discussions little or nothing has been said about reducing the cost of production. Reduced cost of production can more effectively be brought about than an increase of the selling price and will require no legislation. To reduce cost of production of farm products requires an increase in the efficiency of our farm labor through the adoption of improved methods and use of proper equipment just as has been done in the manufacturing industries through the greater application of engineering. For example, in corn growing contests which are conducted in Nebraska by the Crop Improvement Association, it was found that last year the thirty-eight contestants in the eastern part of the state with an average yield of 69 bushels to the acre made an average profit of $9.49 per acre while their neighbors with an average yield of 35 bushels for that section made a profit of 61 cents per acre. The man with the 69-bushel yield made as much profit on one acre as the man with an average yield made on 15 acres. It was further shown that the contestants who used two-row cultivators made a profit of $1.55 per acre above that made by the contestants who used one-row cultivators. The men with the high yields had no more favorable climate nor any better land than those with the low yields. Their results were secured because of their using improved methods, good management and proper equipment. In other words, they had learned how to increase their efficiency by combining several desirable factors.

It must not be assumed, however, that high yields will always bring about greater net returns. We must secure greater production per individual. This may be secured to some extent through increasing the yields but such increase is limited. It will require a combination of the best practices advocated by agricultural specialists with the best engineering practice to bring about an increased individual production as well as maintain acre production on an economic basis.

American Society of Agricultural Engineers. The growing importance of the engineer in agriculture was realized nineteen years ago by a small group of engineers when they met together at Madison, Wisconsin, and organized the American Society of Agricultural Engineers. A very close relationship exists between the Society and the farm equipment industry, and the importance of its work to this industry is rapidly growing in scope and extent.

The work of the Society is carried on by several divisions and committees. The work most closely allied to your industry is conducted by the Farm Power and Machinery Division. As is evidenced by its slogan, "More profit in farming by more efficient use of farm equipment," in this division many committees are hard at work on various problems among which the following are typical:

A study of grain drying equipment is an outstanding problem. The use of the "combine" in humid areas will call for artificial methods of drying grain after threshing. A study is being made of the requirements of grain-drying equipment and of the effect of the treatment upon the grain. This information must be available in order to design proper equipment of this type. Methods of hay drying are also studied with the object of reducing much of the loss of hay in curing. Work along this line has already been done in England and to some extent in this country.

The matter of developing soy bean machinery is receiving considerable attention at this time. The harvesting process for this crop has been a wasteful and unsatisfactory one. The use of the combine has met with considerable success in the harvesting of this crop even in humid regions. The greater use of this soil builder is very important to the farm equipment industry since it will help to maintain the fertility of the soil and thus increase crop yields.

The work of the A.S.A.E. Committee on Ensilage Machinery, through Professor Duffee at the University of Wisconsin, on silage cutters is well known to all of you. This work has brought out the fact that many of the ideas that were prevalent relative to the requirements of silage cutters were erroneous and based largely on guess and prejudice. The results of these tests show that much can be done to improve the operation of machines and to reduce the power requirements if the fundamental principles involved are more fully understood. This is true not only in relation to silo fillers but to all farm operating equipment as well.

Several of our engineers, in cooperation with agronomists are making a study of the soil as to its changes under different conditions. They find that the various factors affecting the condition of the soil may have a very great influence in the design of tillage tools of the future. We must learn just how soil changes under various conditions of climate, moisture content, fertility, structure and different means and methods of working in order to know what type of equipment can be used most effectively and most economically.

In addition to the work at the Wisconsin experiment station on the testing of ensilage machinery, other stations are doing very effective work along various lines such as: The extensive development of various ideas in relation to the improvement of farm machinery at the Iowa State College; the tractor testing work at the University of Nebraska; the soil dynamics work at Alabama; the excellent work done in various lines at the University of Illinois. The very important work on corn borer control to which reference has already been made was done by members of the agricultural engineering staff at Ohio State University.

These are merely a few of the projects. I shall not attempt to review the work in progress at each institution. Suffice it to say that research work of one kind and another, applicable to the farm equipment industry and in which manufacturers should be interested, is carried on at practically all of our experiment stations and colleges where agricultural engineering departments are in existence, largely as a result of the activity within the American Society of Agricultural Engineers. This research work, which is being carried out at the various colleges and experiment stations by the department of agricultural engineering and by other departments in related work, gives results which are of inestimable value to the manufacturers.

An effort to correlate the research work of the various state agencies has been made through the creation by the Secretary of Agriculture of an advisory council. This council is composed of men representing the farm equipment industry and the American Society of Agricultural Engineers. It has conducted an activity during the past year which is hailed as the most constructive undertaking attempted in the history of the farm equipment industry.

The matter of standardization and simplification in the farm equipment industry has made some progress in the past few years but much remains yet to be done. The Society offers the only agency for this work which combines engineering skill, impartiality, vision and that prestige essential to public approval. The Society already has a standards program outlined by members representing the farm equipment industry, but it is imperative that every branch of the industry be represented in working out satisfactory standards.

The widespread interest in adopting electric power more generally in agriculture is certain to have a profound influence on farming methods and equipment of the future. The farm equipment industry must be fully awake to the demands and possibilities of this new development. The Society has under way many important projects along this line in its Rural Electric Division.

(Continued on page 387)

Agricultural Engineering Digest

A review of current literature on agricultural engineering by R. W. Trullinger, specialist in agricultural engineering, Office of Experiment Stations, U. S. Department of Agriculture

A Suggested Remedy of Crankcase-Oil Dilution, R. E. Wilson and R. E. Wilkin (Journal Society Automotive Engineers, 18 (1926), No. 2, pp. 163-170, figs. 11).—Studies are reported on crankcase oil dilution in internal-combustion engines, the results of which suggest the use of a fairly heavy oil of from 500 to 575 seconds viscosity at 100 degrees Fahrenheit, blended with from 10 to 12 per cent of a distillate having a boiling range substantially identical with that found in the average crankcase oil at equilibrium. It was found possible by this means to produce an oil with an initial viscosity around 220 seconds which gave easy starting and good cold lubrication, and yet maintained a viscosity in the optimum range throughout its entire period of service.

Investigations of Warm-Air Furnaces and Heating Systems, II, A. C. Willard, A. P. Kratz, and V. S. Day (Illinois University, Engineering Experiment Station Bulletin 141 (1924), pp. 152, figs. 91).—This is the fourth progress report of studies being conducted in cooperation with the National Warm-Air Heating and Ventilating Association.

Studies of the performance of a cast-iron circular radiator furnace showed that since in practice the furnace is controlled by a combination of dampers which in turn determine the intensity of the draft at the smoke outlet, the draft becomes the controlling factor in furnace operations, and the other factors necessarily become functions of or are dependent upon the draft. In order to warm the house rapidly, combustion rates much higher than the average daily rate are required for short periods of time. In order to meet these conditions a satisfactory chimney must produce a draft intensity of from two to three times the differential draft required for the average rate of combustion on which the design of a plant is based.

A series of tests using anthracite coal and one using bituminous coal, to compare the performance of the same furnace operating with anthracite and bituminous coal and to determine the effect of the use of a slotted fire pot on the operation with bituminous coal showed that within practical combustion rates the anthracite coal gave higher capacity and efficiency than the bituminous coal for the same combustion rate. However, the reverse was true at combustion rates that are excessive for warm air furnace practice. In the case of the bituminous coal the efficiency was more nearly constant over the whole range of combustion rates than it was for the anthracite coal. At any given combustion rate more draft was required to operate the furnace on anthracite than on bituminous coal. With bituminous coal, as fired under the conditions of the tests, the slotted fire pot gave about 9 per cent higher efficiency and capacity than the fire pot with the slots sealed.

Accumulations of soot in the bituminous coal tests amounted to about 1.5 pounds at low combustion rates and were negligible at high rates. At low rates the soot collected on the inner surface to a depth of about ⅜ inch, while at high rates the surface remained practically free from soot.

Experiments on the performance of a steel crescent radiator furnace as compared with the cast-iron circular radiator furnace showed that the steel furnace requires greater draft differential between the smoke outlet and the ash pit to operate at a given combustion rate. The efficiency was higher for the steel furnace and was more nearly constant over the whole range of combustion rates. The capacity developed at the bonnet was practically the same for the two furnaces. The results are taken to indicate in general the desirability of high ratios of heating surface to grate surface.

Experiments on the effect of varying the casing diameter showed a similar effect for the two types of furnaces. Beginning with the smallest casing a decrease in capacity and efficiency occurred when the casing diameter was enlarged 2 inches. The next increase in casing diameter resulted in an increase in efficiency and capacity, while a still further increase in casing diameter again resulted in a decrease in efficiency and capacity.

The best results were obtained in both furnaces with a casing having a ratio of free area to gross area of approximately 0.46 and a ratio of free area to leader area of 1.35. The 50-inch casing was the smallest that is was practicable or possible to use. The data indicate that a somewhat further reduction in casing size may give still greater capacities per square inch of free area through the furnace. However, it was found that when the ratio of leader pipe area to free area is increased much above 1 to 1, the plant may breathe, or some one of the warm air pipes may act as a cold air duct.

Experiments are reported on three bonnet constructions including (1) a conical bonnet with side outlet collars, (2) a cylindrical bonnet with side outlet collars but with leader pipes in the same position as in (1), and (3) a shallow cylindrical bonnet with elbow outlets in the top, leader pipes horizontal, and tops of leaders at the same elevation. For combustion rates below nine pounds of coal per square foot of grate area per hour the third bonnet gave 10 per cent more heat available at the register than the first bonnet, and 3 per cent more than the second bonnet. Above this combustion rate, however, the performance of the third bonnet fell below that of the second bonnet, and at still greater combustion rates it fell below that of the first bonnet. The weight of air did not increase in the third bonnet as rapidly as in the first and second bonnets. At any given register air temperature above 200 degrees Fahrenheit the bonnet capacity was lower for the third bonnet than for the first or second bonnets. At a combustion rate of ten pounds of coal per square foot of grate per hour the register air temperature for the third bonnet fell below that for the second bonnet, and at a combustion of a little over eleven pounds it fell below that for the second bonnet, and at a combustion of a little over eleven pounds it fell below that of the first bonnet. The results are taken to indicate that the cylindrical bonnet with side outlets was the most satisfactory over the entire range of operation of the furnace.

Tests of two types of recirculating ducts showed that the round duct with 45 degree elbows and without the unsatisfactory right angle bends of the rectangular ducts handled a much greater quantity of air and developed a greater amount of heat available at the registers than the rectangular duct.

Tests of a centrifugal fan as an auxiliary to a furnace heating system showed that the increase in the weight of air passing through the furnace in pounds per hour when the fan was running was equal to the fan capacity in pounds of air per hour in only one case; hence there was practically never any inductive action produced by the fan and nozzles, as the increase in weight of air flowing was less than the fan capacity in pounds of air per hour except at one temperature.

Tests of the effect of register grilles on piped furnace plant capacity showed that no increase in capacity was indicated in the case of the open register boxes on the hot side of the system. No appreciable increase in capacity was indicated in the case of open faces with the sloping top plates on the hot side. An increase in capacity of 6.5 per cent at high temperatures, 4 per cent at moderate temperatures, and 1 per cent at low temperatures resulted when the cold air register was removed. These results are taken to indicate that warm air register grilles do not offer an appreciable resistance to the flow of heated air, provided the free areas are not reduced below 70 per cent of the gross areas.

Studies of heat emission from the heating surfaces for three types of furnaces showed that the heat emitted from the heating surfaces is independent of the type or size of casing or bonnet. The heat absorption by the circulated air was found to be affected by variations in the types of casings used. The data indicate that in general when the ratio of heating surface to grate surface is low, the unit heat emission is high, but that the higher unit emission is brought about by corresponding higher surface temperatures. The data also indicate that the ash pit is effective heating surface, although it is not ordinarily included as such. It was also found that the unit heat emission from the fire pot decreased with increasing combustion rates when bituminous coal was used. Experiments on the effect of inner casing and radiation shields on furnace performance showed that marked increases in furnace efficiency, capacity, and register air temperature resulted from the use of the radiation shield, the increase in capacity amounting to 7.5 per cent at an average rate of combustion. No difference could be detected between the performances with the short and the long shields. The actual heat available at the registers of the plant for any assumed rate of combustion was increased approximately 8.5 per cent by the use of the shield. Intercepting the radiant heat from the hot castings reduced the casing temperatures from 150 to 105 degrees at low rates of combustion and much more at high rates, and reduced the heat losses about 0.25 or 3 per cent of the heat of the fuel. The temperature of the shield ranged from 310 to 510 degrees, approximately the same as the temperature of the ash pit.

Tests of insulation and heat loss of a furnace showed that for the same combustion rate substantial increases in capacity and efficiency resulted from the insulation, and that higher register air temperatures were obtained. The efficiency of the furnace increased from 60 to 66 per cent at the moderate combustion rate of six pounds of fuel. The principal reduction in heat loss was obtained from the furnace front, although some saving resulted from the insulation of both bonnet and floor. The use of insulating material on leader pipes showed no beneficial effect on furnace economy or heating capacity.

Studies of the heat loss from wall stacks showed that from the standpoint of over-all thermal efficiency with the same internal stack dimensions the double wall stack is the best, but that with the same external dimensions the single wall stack is to be preferred. The nonvented stack had the greatest heat delivering capacity at the register because of the higher mean air temperature in the stack and the resulting greater motive head.

Studies of the heat carrying capacity of leaders showed that there was a large increase in the heat available at the register per square inch of leader for any given leader and stack as the register air temperature was increased, and as the height of the stack was increased. This was especially true with regard to the

leader when increasing the height from the first to the second floor level.

Experiments on the performance of leaders and stacks as affected by stack and leader size showed that the heat carrying capacity of a leader is not proportional to the area of the leader, but is more nearly proportional to the area of the stack provided the stack is always as small as or smaller than the leader.

Experiments on the performance of leaders and stacks as affected by the height of stacks showed that for a given register air temperature the relation of heating effect to height is not a direct one; the heating effect increased at a lesser rate than the height. For a constant heat input to the furnace the heating effect may be actually reduced as the height is increased.

Experiments on humidity and evaporating pans showed that the proper humidification can not be obtained by placing pans on low temperature surfaces, such as hot water or steam radiators unless their excessive amount of water surface is exposed. Water temperatures of from 120 to 130 degrees were found to represent the maximum that can be obtained by such arrangements.

Drainage on the Farm, W. W. Weir (California Station Circular 304 (1926), pp. 30, figs. 30).—This circular is intended to cover the principles and methods of drainage of wet lands in California, and is applicable to those parts of the state which do not require the special considerations essential in the drainage of lands where alkali is a factor.

A Method for Testing Gas Appliances to Determine Their Safety From Producing Carbon Monoxide, E. R. Weaver, J. H. Eiseman, and G. B. Shawn (U. S. Department Commerce, Bureau Standards Technology Paper 304 (1926), pp. 125-154, figs. 25).—The causes which result in the liberation of carbon monoxide from gas appliances are briefly discussed, together with the character of the tests which must be applied to determine the relative safety of different appliances in use.

The results of tests upon numerous appliances are given in graphic form, both to illustrate the application and value of the testing methods, to show the range of hazard in existing appliances, and to indicate what may reasonably be expected of a good appliance in service. It is shown that all types of appliances commonly used, such as ranges, water heaters, radiant room heaters, etc., can readily be made safe from the carbon monoxide hazard, but that there is no certain way except by a laboratory test by which even an experienced person may judge whether an appliance is or is not operating safely.

Progress in the Measurement of Motor Fuel Volatility, T. S. Sligh, Jr. (Journal Society of Automotive Engineers, 18 (1926), No. 4, pp. 393-396, figs. 3).—In a contribution from the U. S. Bureau of Standards laboratory test methods of indicating the volatility characteristics and the starting capability of fuels used in internal-combustion engines are described, together with the testing apparatus and procedure.

Farm Implements in Scotland—Historical Notes, I, II, J. A. S. Watson (Scotland Journal Agriculture, 8 (1925), No. 4, pp. 359-366, figs. 6; 9 (1926), No. 1, pp. 46-54, figs. 6).—The first part of this contribution from Edinburgh University describes implements in use in Scotland during the time between 1300 and 1700. The old Scots plow appears to have been built in all districts according to the same general principles, but there was a great deal of variation in the weight of the materials used and perhaps still more in the standard of workmanship. The whole structure, with the exception of the sock colter and bridle, was of wood and the various parts were mortised and pinned together. The main framework consisted of a substantial beam mortised into the left hand stilt, which in turn was mortised into the rear portion of the so-called head which was the horizontal piece carrying the sock. The beam and head were connected by a sheath which sloped backward at an angle of 60 degrees with the head. The total length of the frame from the handle of the stilt to the end of the beam was ordinarily about 13.5 feet.

The so-called cas-chrom was an implement of great antiquity and was in very wide use in the Highlands and the Hebrides up until the eighteenth century. It consisted of a stout piece of oak or ash with a shaft about 5 feet 9 inches long. The head, about 2 feet 9 inches in length and usually of the same piece as the shaft, was flattened and chisel-pointed, and set to the shaft, at an angle of about 120 degrees. The point was shod with iron. A stout wooden peg, to which the right foot of the laborer was applied, was inserted into the head on the right-hand side near its junction with the shaft.

The old Scots harrow was rectangular in shape and about four feet square. It usually consisted of four "bulls," each carrying five teeth connected by four slots. Originally the whole implement was made of timber. Toward the end of the seventeenth century iron teeth replaced the wood. The harrow was drawn by a corner in order that the teeth might each follow a separate track, but it is obvious that the work accomplished was very unequal, since the middle portion of the ground passed over received most of the effect, while the edges were left very imperfectly tilled.

Rollers were known in Scotland before 1700, but only a very small proportion of farms were equipped with them. The old types of roller were usually made from the solid trunk of a tree or of stone. Previous to the eighteenth century the cylinder was always in one piece, but about in 1750 the idea of dividing it in two to facilitate turning was introduced.

In the second contribution eighteenth century improvements on farm implements used in Scotland are described and illustrated. The first notable step in the improvement of these machines was the introduction of the winnowing machine in 1710. During the eighteenth century several new principles were applied to the construction of the plow, and by 1800 a type quite similar to modern forms was evolved. Four separate improvements were made on the plow. The first was the introduction of the feathered sock, by means of which the furrow slice was partly separated on its under side by cutting. The second was the alteration of the moldboard from the practically straight form by carefully calculated curvature. The third was the abandonment of wood in favor of iron for the moldboard, and the fourth was a material reduction in weight without much loss of strength.

Descriptions of threshing machines, drill husbandry, and harrow types are also included.

The Permanent Hog House, H. M. Ward (Building Age, 48 (1926), No. 3 pp., 118, 119, figs. 5).—Drawings showing structural details and a table of quantities of materials for permanent hog houses are presented.

The Absorption Refrigerating Machine: Advanced Practice and Theory, G. T. Voorhees, (Chicago: Nickerson & Collins Co., 1924, pp. 165, (pls. [21] figs. [6]).—This is a complete technical treatise on absorption refrigerating systems which contains not only the fundamental principles but also detailed data for the design and construction of the absorption machines for all working conditions.

Cost of Agricultural Power, B. Victor (Technik Landw., 5 (1924), No. 9, pp. 171-173, figs. 5).—Comparative data on the cost of power for agricultural operations from steam engines, crude oil engines, gasoline engines, and portable electric motors are graphically reported. Engines and motors of from 6 to 8, 10 to 12, 15 to 20, and 25 to 30 horsepower were tested as were also 2 horsepower gasoline engines and electric motors.

The power cost per hour curves for the different machines showed a marked similarity. Electricity was found to be the most efficient power source where small power units were required for short periods of time, although it was approached closely by the crude oil engine in this respect. However, electricity was not always the most efficient source of power, being frequently less efficient than the crude oil and gasoline engines, especially with the larger power units and longer periods of operation. It was even less efficient on an annual basis than steam for machine units of from 15 to 30 horsepower. The most uniformly efficient source of power on an annual basis was the gasoline engine, followed closely by the crude oil engine.

The data are taken to indicate, however, that efficiency in the use of power in German agricultural operations depends not so much on the source of the power as on the conditions under which it is used and the extent to which they are met.

Practical Water-Power Engineering, W. T. Taylor (New York: D. Van Nostrand Co., 1925, pp. VII+270, pls. 4, figs. 28).—A treatment of technical and commercial factors in water power engineering is presented in this book, special reference being made to field work involving a study of stream flow, pondage capacity, developed waterways, and power transmission lines. Chapters are included on hydraulics and water power development; catchment, rainfall, and run-off; selection of water power sites; storage and pondage; stream flow; the gravity conduit; pressure pipe lines; hydraulic losses; automatically controlled small water power plants; reporting on a water power project; water legislation; high-voltage power transmission; power transmission line calculations; and overhead electric power transmission economics.

Preliminary Report on the Geology and Water Resources of the Mud Lake Basin, Idaho, H. T. Stearns and L. L. Bryan (U. S. Geological Survey, Water-Supply Paper 560-D (1925), pp. IV+87-134, pls. 2, figs. 2).—Studies conducted in cooperation with the U. S. General Land Office, Idaho Department of Reclamation, and Idaho Bureau of Mines and Geology of a region lying some distance north of Idaho Falls and covering approximately 4,000 square miles, are reported.

The data indicate that the total supply of water which appeared at the surface in Mud Lake and vicinity from April 1, 1921, to March 31, 1922, amounted to about 162,000 acre-feet, of which 95,000 acre-feet appeared in Mud Lake, 26,000 in five smaller lakes or reservoirs, and 41,000 was discharged by evaporation and plant growth. Of the total that appeared at the surface, about 96,000 acre-feet or a little more came from underground sources, about 47,000 acre-feet flowed into Mud Lake from Camas Creek, and 19,000 acre-feet fell upon the wetted area as rain or snow. The aggregate flow of Camas and Beaver Creeks amounted to 143,000 acre-feet during the year ended March 31, 1922. A large part of this water apparently reappeared at the surface in Mud Lake and vicinity.

The data show that the supply of Mud Lake for the year ended March 31, 1923, was greater than that for the previous year, indicating that the supply of Mud Lake is still increasing. It is stated that conditions do not appear to be promising for diminishing the natural losses from the area by further diking the lakes so as to decrease their areas. The natural losses will, however, be diminished by a more nearly complete utilization of the water.

It is also suggested that another promising possibility is to reduce the evaporation, transpiration, and percolation losses by pumping from wells where the ground water is nearly at the surface and where the water bearing lavas are very permeable.

Development and Present Status of Community Agricultural Warehouses in Bavaria [transaction title], E. Hohenegg (Landw. Jahrb. Bayern, 15 (1925), No. 5-6, pp. 167-232, pl. 1, figs. 12).—A large amount of information on the development and use of agricultural warehouses in Bavaria is presented.

A Process for the Reclamation of Crankcase Oil, C. D. Miller (Bus Transportation, 5 (1926), No. 1, pp. 6-9, figs. 7).—In a contribution from the Alabama Experiment Station an explanation is given as to why uncertain results have been obtained in efforts to purify used crankcase oil by certain processes, and a two-stage method which promises more successful results is outlined.

In the first part of this method the solid matter is removed and in the second the absorbed motor fuel is removed to restore the oil to its proper viscosity. The first part is essentially a washing with hot water containing washing powder in solution. The absorbed motor fuel is removed and the oil returned to its proper viscosity by placing the cleaned oil in a tank in which it is heated to a temperature of 350 to 380 degrees Fahrenheit and steam blown through it. Both the steam and the high temperature are essential to the removal of the heavy ends of the fuel. With the steam passing through and opening up the mass of liquid, the fuel ends are readily and completely removed.

Building the Farm Dairy House, L. W. Morley (Pennsylvania State College Extension Circular 107 (1925), pp. 9, figs. 4).—Drawings, information, and a list of materials for building the farm dairy house for Pennsylvania conditions are presented.

Progress on the South Dakota Farm Electric Test Line at Renner, R. L. Patty (C. R. E. A. Bul. [Chicago], 2 (1925), No. 11, pp. 1-7, figs. 7).—In a contribution from the South Dakota Experiment Station a description is given of the work on the use of electricity in agriculture by the station, and the progress of experiments on the test line at Renner is reported.

It has been found that the total cost of electric service on this farm line will include the fixed charge of $8 per month, the interest and depreciation on the stub line, on the wiring and fixtures of the building, and on the electric motors and appliances, plus the energy rate of 5 cents and 3 cents per kilowatt hour.

The average amount of energy used at each farm during January was 41.12 kilowatt-hours. It increased to 50 kilowatt-hours during February, and then remained at about 45 kilowatt-hours per month until August. It then increased and reached 117.5 kilowatt-hours in December. It is noted that in December, when the largest amount of energy was used, the average electric light bill was relatively small, although almost three times as much energy was used as in the previous January.

Generation of Explosive Gases in Electric Water Heaters and Boilers, J. W. Shipley and A. Blackie (Engineering Journal [Canada], 9 (1926), No. 2, pp. 55-59, fig. 1).—Studies conducted at the University of Manitoba are reported which showed that gases of an explosive nature are generated in water heaters operating on bare submerged electrodes using 220 or 110-volt, 60-cycle alternating current. The nature of the gases depends upon the material of the electrodes. Carbon electrodes give hydrogen, oxygen, carbon monoxide, carbon dioxide, and hydro-carbon gases. Aluminum electrodes generate hydrogen and oxygen most vigorously, the oxygen being largely fixed as hydrated oxide of aluminum. Iron electrodes produce hydrogen and oxygen, with possibly a little carbon dioxide. The oxygen is largely fixed in the electrode chamber as hydrated oxide of iron.

The gases accumulating in the system are due to degassing of the water, the action of the water on iron producing hydrogen, and the generation of gases by the electrolysis of the water by alternating current. Frequent surging of the water from the expansion tank into the electrode chamber brings in dissolved atmospheric gases. Nitrogen and carbon dioxide dilute the explosive gases, but oxygen enhances the possibility of an explosion.

The rate of generation with fixed electrodes is largely a function of the electric current flowing and the temperature. Apparently a larger volume of hydrogen is generated near the boiling point than the temperature coefficient of the conductivity of the electrolyte will account for. Gases may be generated by the electric current in other parts of the system outside the electrode chamber. This is due to the intimate contact of the electrolyte with the whole metallic system, and to the practice of electrically grounding the shell.

Steam reduces the explosiveness in so far as it dilutes the gases. The range of explosibility of hydrogen and oxygen mixtures is too great, however, always to permit the prevention of an explosion by the presence of steam in the gases generated. Gases generated by the 220-volt, 60-cycle current using iron electrodes in a water heater were found to explode in the presence of steam when fired by an electric spark.

The danger of ignition of the gases generated was found to be greater with heaters provided with electrodes entering from the top. Whenever the electrolyte is depressed so that one of the electrodes is completely bared, an arc will be produced. Other conditions may also arise within the electrode chamber causing the production of a spark sufficient to ignite the gases generated.

It is concluded that the explosive nature of the gases generated in this type of domestic water heater makes reliance upon automatic venting extremely hazardous. Since the generation of gases is a function of the alternating current electrolysis of water, all types of heaters in which the passage of the electric current through the water within the heater is possible can only be operated in the expectancy of having explosive gases generated.

Electric boilers operating on alternating current with bare submerged electrodes were found to generate equivalent quantities of hydrogen and oxygen, and these are carried out of the electrode chamber with the steam, accumulating wherever the steam is condensed. If raw water is used in the boiler, these explosive gases will be diluted with the gases of the atmosphere dissolved in the feed water. If condensate is used the accumulation will more nearly approximate a mixture of hydrogen and oxygen of the maximum explosibility. Explosive mixtures of hydrogen and oxygen were found in air-locked radiators and escaping from the air valve of radiators provided with steam generated by an electric boiler operating on 2,200-volt, 60-cycle, alternating current.

It is concluded that an explosion hazard exists in those parts of a system provided with steam from electric boilers wherever there is a possibility of gases accumulating from the condensate.

The Stovepipe or California Method of Well Drilling as Practiced in Arizona, H. C. Schwalen (Arizona Station Bulletin. 112 (1925), pp. 103-154, figs. 26).—A detailed description of this method as it is used in Arizona and of the apparatus is presented. Strictly speaking, the stovepipe method of well drilling is the drilling of wells with a mud scow, using the stovepipe casing which is forced down with hydraulic jacks. The mud scow is a drilling tool similar to the ordinary sand bucket or bailer, but it is made extra heavy and is equipped with a heavy steel cutting shoe. It serves both as a drilling tool and as a bailer for cleaning out the hole. In Arizona the drilling is often done with solid tools or a combination of both solid tools and the mud scow.

Plow Moldboards, M. Ringelmann (Compt. Rend. Acad. Agr. France, 11 (1925), No. 27, pp. 737-743).—Experiments on the draft of three plows, one having a cylindrical moldboard, one a helicoidal moldboard, and one a nearly flat moldboard with a nearly horizontal point are briefly reported.

The plow with the cylindrical moldboard had the lightest draft. The drafts of the plows with the helicoidal and flat moldboards were 26 and 60 per cent greater, respectively. There was such a sharp angle between the flat moldboard and the horizontal point that compacted soil lodged in the angle during operation, forming a new moldboard surface with a consequently very high coefficient of friction. The conclusion is drawn that the shape of the moldboard rather than the composition of the metal surface is the governing factor in the draft of moldboard plows.

Machine for the Determination of the Pliability of Prepared Roofing and the Breaking Point of Bitumen, C. S. Reeve and F. W. Yeager (American Society Testing Materials Proceedings, 25 (1925), pt. 2, pp. 385-389, fig. 1).—A machine is described which operates on the principle that when a piece of roofing is bent at a given temperature over a 3/16-inch mandril until cracks appear in the coating, the angle through which the piece is bent is a measure of the pliability of the product at that temperature. Results are presented to show the range of reproducibility for the same and different operators. The use of the apparatus for the determination of the breaking point of bitumen is also developed.

A Year's Progress With South Dakota's Farm Electric Test Line, R. L. Patty (South Dakota Agricultural College Extension Circular 232 (1925), pp. 19, figs. 12).—The results of a year's work with a low voltage electric power line in the community around Renner, South Dakota, are briefly summarized. The line is a 2,300-volt, single-phase, ungrounded, No. 6 copper wire line, built especially for farm service, and is 8.4 miles long exclusive of the stub lines into the buildings. Each farm has a separate transformer. There are seventeen farms on the line, averaging two farms to the mile. The type of farming on this line is largely dairy, there being an average of eighteen milk cows per farm.

The work thus far has dealt with water pumping, grinding feed and shelling corn, machine milking, separating cream from milk, operating home pressure water systems, cleaning grain, operating a lineshaft for belt-driven machinery, sawing wood, refrigeration, operating household equipment, heating water for stock, and lighting poultry houses.

The results so far indicate that while 3 kilowatt transformers may prove large enough for the average farm, they will not be large enough for all of the farms. It has been found to pay to use as small a motor as possible for such work as feed grinding, as better service may be had at a lower rate if a small motor is run three or four hours than a large motor one hour. The load is thus spread out more uniformly throughout the day and the peak load does not go so high. It has been found that the peak load on this farm line always comes in the evening at chore time. This is considered to be a characteristic of a farm line in a dairy community, owing largely to the operation of the milking machines. It is also thought that electric ranges will make this condition worse because they will also be in use at chore time, thus causing the peak load to go still higher. It has been found that electric lights in the barns and buildings save a great deal of time in doing chores.

Cost data on the performance of specific operations by electricity are presented and briefly discussed.

Dairy Barns for Montana Farms, H. E. Murdock, R. M. Merrill, and J. O. Tretsven (Montana Station Circular 130 (1925), pp. 22, figs. 15).—Information on the planning and construction of dairy barns to meet Montana conditions is presented, together with drawings of structural details and equipment.

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RAYMOND OLNEY, Editor

A Tribute to the Engineer

THE Engineer with his pencil and drafting board, his work shop and test laboratory, holds the progress of civilization in the palm of his hand. He is mightier than kings and potentates. Actually, "the pen is mightier than the sword," when the pen is held by the Engineer.

The surgeon is helpless without the instruments, buildings and other facilities provided by the Engineer; the farmer, the manufacturer, the baker, the merchant cannot function without the tools built by the Engineer. Imagine a world without the Engineer—with only the transportation of the Indian, the home of a cliff dweller, the food of a roving nomad, and the hardships of a central African cannibal. The food we eat, the water we drink, the clothing we wear, are all provided by the Engineer, and largely by the Agricultural Engineer.

Civilization without the Engineer is unthinkable and impossible.

E. A. STEWART

Associate Professor of Agricultural Engineering, University of Minnesota

(EDITOR'S NOTE: Prof. Stewart says that while he was in Europe he was impressed so many times with the lack of engineering applied to agriculture, that it gave him the inspiration for the above tribute to the engineer.)

Scouting for Committee Timber

THE engineering principle of selecting and employing the most efficient material for a given purpose has its broader application in the ever-present human problem of finding the best man for any given task. This problem is one felt keenly by every president of our Society in making committee appointments. Even with the advice of the Council, the data available in the Secretary's office and the suggestions of members with whom he has personal contact, an appointing officer always is beset by the fear that he may be overlooking better talent than that which he selects.

With a membership as far flung as ours the danger of lights remaining hidden under a bushel is considerable, and increases with the growth of the Society. During the early years our numbers were small and members were pretty well known one to another. But as we grow in membership, as in prestige and achievement, the continuance of this happy condition becomes increasingly more difficult. This small handicap in our expansion can and must be overcome.

The appointing officer is limited by the information at his disposal. He cannot appoint a man, however capable, unknown to him. In behalf of future presidents it is urged that every member who knows of men qualified for any special phase of Society work should make known the facts, either directly to the appointing officer or through the Secretary's office, as a sort of informal nomination. As a matter of common sense modesty should not keep a man from making known his own contact with work in hand or in prospect, and such suggestions may be made with equal propriety in either the first or third person.

It must be understood also that the best man for a certain job is not better than any other member; it is not a question of sheer talent but of specific adaptation. In making a final selection there must be taken into account many incidental considerations, such as geographical location in cases where the nature of work requires that the committee meet in conference, so that no criticism attaches, either to the appointive power or to the man involved, when a candidate is not assigned to the work for which he has been suggested.

But before applying such incidental factors it is important that there be available a bird's-eye view of the talent available, and to such end this appeal is directed.

Accuracy in Nomenclature

ANOTHER issue as to accuracy in nomenclature has arisen in connection with the use of the word "permanent" as applied to building material. The protagonists of wood as a structural material point out that no material is permanent in an absolute sense, observing that our soils are but the ruins of destroyed rock, the most resistant as well as the weaker products of Nature's laboratory. In particular these people challenge the appropriation of the term "permanent" in behalf of certain materials to the exclusion, at least by implication, of wood.

Attention is drawn to the large number of colonial dwellings which are revered for their associations with important persons and events in the early history of our country, admired for their architectural values, and continued in use as residences because in points of comfort, beauty, and spaciousness they still are able to compete with homes of recent erection. These homes, which almost invariably are of wood, have survived generation after generation of mankind, and may rightfully be admitted to that comparative degree of permanence which is the most that can be claimed for any material.

It is, of course, understood that wood exhibits no such degree of permanence under complete neglect. But it is pointed out that if wood in contact with soil or with damp masonry is treated with a suitable preservative and if surfaces exposed to weather are protected by paint, it thereby acquires a degree of permanence unexcelled by any building material. The relatively high standing of wood as a comparatively permanent building material is more apparent when that permanence is reckoned not by the mere survival of the material as such, but by the building as a whole remaining in such condition as to serve satisfactorily the purpose for which it was designed. From the standpoint of the engineer the measure of permanence is not how long a thing will remain as a recognizable ruin, but how long it retains its desirability as a habitation.

In consequence of these considerations, it is urged that engineers employ the word "permanent" with discretion, at least until such time as there shall be established an authoritative definition as to what constitutes a practical degree of permanence.

English Report on Artificial Drying of Crops in Stacks

UNDER the title, "Preliminary Report of an Investigation into the Artificial Drying of Crops in Stacks," the Institute of Agricultural Engineering of the University of Oxford, St. Giles, Oxford, England, has just issued as Bulletin No. 2 an exhaustive report of experiments in the artificial drying of hay and grain crops in the stack.

A. S. A. E. and Related Activities

Pacific Coast Section Schedules Meeting for December

THE Pacific Coast Section of the American Society of Agricultural Engineers, according to advice received at Society headquarters from the chairman of the section, W. W. McLaughlin, "is fully recovered from its dissipation at the Tahoe meeting," and at a meeting of the executive committee of the section held recently, it was decided to hold a semi-annual section meeting at the Engineer's Club, San Francisco, December 11.

There will be two sessions, one in the afternoon and one in the evening. The afternoon session will be devoted to the presentation of problems in Western reclamation development divided into two main divisions: (1) Agricultural engineering and (2) financing. The agricultural engineering phases of the subject will be handled by Ray B. West, professor of agricultural engineering, Utah Agricultural College, and vice-chairman of the section; Leslie W. Symmes, consulting agricultural engineer; and P. E. Holt, chief engineer, Caterpillar Tractor Company. The financing phase of the subject will be handled by William Durbrow and J. V. Mendenhall. The principal thought underlying the discussions will be an engineered agriculture and the field of the consulting agricultural engineer.

The evening session will be devoted to less serious matters. To this meeting the ladies will be invited and the session will start off at 6:30 P.M. with a banquet, during which, according to advices received from the chairman of the section, the usual "hot air" will be dispensed. Following this part of the program there will be checkers and dominoes for the young folks with cards and dancing for the older members. The time limit is the last ferry boat to the East Bay Section. The entertainment committee will be headed by J. Dewey Long, of the agricultural engineering division of the University of California, who "threw the Monkey-Wrench" into the annual meeting at Lake Tahoe.

Any A.S.A.E. member, whether or not a member of the Pacific Coast Section, knowing the reputation of the Pacific Coast group for putting on a meeting, will certainly not want to miss this meeting if within reasonable distance of San Francisco on December 11 and it is otherwise humanly possible for him to attend.

Farm Machinery and Tractor Program

A THREE-DAY farm machinery and tractor meeting—the program for the first and second day to be arranged for and presented by the Farm Power and Machinery Division of the American Society of Agricultural Engineers and the program for the third day in charge of the Agricultural Equipment Division of the Society of Automotive Engineers—will be held at the Hotel Sherman, Chicago, December 1, 2, and 3, 1926. The accompanying program gives the titles of papers to be presented on this program and the names of the speakers who have been secured.

Thomas D. Campbell, the world's premier "manufacturer" of wheat, says the combined harvester-thresher is the most outstanding development in farm machinery of all time. Because of the importance of the "combine" to American agriculture and the revolutionary influence it is bound to have not only on the production of wheat, but also on agriculture as a whole in this country, the entire first day of the A.S.A.E. program is to be devoted to the combine. This program will be opened by Fred A. Wirt, a past-president of A.S.A.E., who will relate the history of the spread of the combine and the probable future extension of its use to other areas, notably the humid areas, and its possibilities for uses other than the harvesting of grain.

The division of agricultural engineering of the U.S.D.A. Bureau of Public Roads in cooperation with two other bureaus of the federal department of agriculture have made extensive field investigations of harvesting with the combine. The results of these investigations will be presented by C. D. Kinsman of the U. S. Department of Agriculture.

Field tests on combines in several states of the United States and in two provinces of Canada, as well as general field investigations by engineers associated with the development of combines will be presented in the nature of a symposium at the afternoon session of the first day.

The same session will also feature some development work by the International Harvester Company on the drying of combined grain under humid conditions, which will be presented by C. O. Aspenwall, experimental engineer for that company. Capt. B. J. Owen, director of the Institute of Agricultural Engineering, University of Oxford, has been invited to discuss this particular subject as extensive tests have been made on the drying of grain in England. It will also be discussed by Wm. Aitkenhead, professor of agricultural engineering at Purdue University, who has recently conducted drying tests.

Interesting developments have been made recently in the motorization of corn production both in Ohio and Nebraska. This subject will feature the tractor program to be presented at the morning session on December 2 and will be presented by G. W. McCuen and E. E. Brackett, professors of agricultural engineering at Ohio State University and the University of Nebraska, respectively.

A great deal has been spoken and written recently about the industrialization of agriculture, applying the principles and practices that have made America's manufacturing industries great to the industry of agriculture. Thomas D. Campbell, president of the Campbell Farming Corporation, Hardin, Montana, is putting those principles into practice; he has made a success of engineering or industrializing his farming operations. One of the principal features of the A.S.A.E. tractor program will be an address by Mr. Campbell on how he "manufactures" wheat on his 100,000-acre farm-factory. He is attending the meeting and has consented to appear on the program primarily because of the opportunity it will give him to have a heart-to-heart talk with tractor and farm-machinery designers. Mr. Campbell was a mechanical engineer before he took up his famous farming project and he has a great deal to say to farm-machinery designers about what the industrialization of agriculture demands in the way of improved farm equipment.

The subject of the power take-off was discussed at considerable length at the A.S.A.E. farm-machinery meeting in December 1924. At the meeting next month F. N. G. Kranich, of the Timken Roller Bearing Company, will discuss important developments that have taken place since that time.

Recognized as one of the outstanding engineers in the development of the general-purpose tractor, B. R. Benjamin, experimental engineer of the International Harvester Company, will present a paper on the recent developments in the general-purpose tractor which will be accompanied by a motion picture film, which has so far never been released, on the latest developments in the design of the Farmall tractor.

In tractor lug research studies at the Alabama agricultural experiment station a close correlation has been found between the results of the laboratory studies reported at the meeting of the Farm Power and Machinery Division in December, 1925, and the results of the field studies with tractors made recently. Lug combinations can be made which will permit a tractor to develop its rated power on loose sand. In a paper, entitled "Field Tractor Lug Studies," John W. Randolph, associate professor of agricultural engineering at the Alabama Polytechnic Institute, will present the results of these studies.

Program

Meeting of the Farm Power and Machinery Division
of the
AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS
Hotel Sherman, Chicago, Dec. 1 and 2, 1926

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FIRST DAY—DECEMBER 1

Morning Session

9:00 A.M. Registration—"Round-up and Branding Hour"

10:00 A.M. PAPER: "Spread of the Combine"—Fred A. Wirt, J. I. Case Threshing Machine Company

11:00 A.M. PAPER: "Results of U.S.D.A. Investigations of Harvesting With the Combine"—C. D. Kinsman, agricultural engineer, U. S. Department of Agriculture

Afternoon Session

2:00 P.M. SYMPOSIUM: "Field Tests of the Combine"—
(1) In Wisconsin—F. W. Duffee, University of Wisconsin
(2) In Illinois—I. P. Blauser, University of Illinois
(3) In Pennsylvania and Delaware—R. U. Blasingame, Pennsylvania State College
(4) In Ohio—G. W. McCuen, Ohio State University
(5) In North Dakota—R. C. Miller, North Dakota Agricultural College
(6) In Indiana—R. H. Wileman, Purdue University
(7) In Saskatchewan—E. A. Hardy, University of Saskatchewan
(8) In Alberta—J. M. Smith, University of Alberta
(9) W. F. MacGregor, J. I. Case Threshing Machine Company
(10) B. J. Harris, Massey-Harris Company, Ltd.

3:30 P.M. PAPER: "Drying of 'Combined' Grain Under Humid Conditions"—C. O. Aspenwall, experimental engineer, International Harvester Company

Discussion—B. J. Owen, director, Institute of Agricultural Engineering, University of Oxford, England

Wm. Aitkenhead, professor of agricultural engineering, Purdue University

SECOND DAY—DECEMBER 2

Morning Session

9:00 A.M. Personal Contact Hour (Informal)

10:00 A.M. PAPER: "Latest Developments in the Motorization of Corn Production"—G. W. McCuen, professor of agricultural engineering, Ohio State University

Discussion—E. E. Brackett, professor of agricultural engineering, University of Nebraska

11:00 A.M. PAPER: "Manufacturing Wheat on a 100,000-Acre Farm-Factory, With Special Reference to Farm Machinery Design"—Thomas D. Campbell, president, Campbell Farming Corporation

Afternoon Session

2:00 P.M. PAPER: "The Power Take-Off Up to Date"—F. N. G. Kranich, manager, tractor and implement department, Timken Roller Bearing Company

2:30 P.M. PAPER: "Recent Developments in the General Purpose Tractor"—B. R. Benjamin, experimental engineer, International Harvester Company
(This paper will be accompanied by a motion picture film on the latest developments in the design of the Farmall tractor.)

3:30 P.M. PAPER: "Field Tractor Lug Studies"—John W. Randolph, associate professor of agricultural engineering, Alabama Polytechnic Institute

4:00 P.M. PAPER: "Possibilities in Tractor Research"—J. B. Davidson, professor of agricultural engineering, Iowa State College

Discussion—O. B. Zimmerman, experimental engineer, International Harvester Company

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Tractor Program

of the
SOCIETY OF AUTOMOTIVE ENGINEERS
Hotel Sherman, Chicago, Dec. 3, 1926

PAPER: "The Use of Tractors and Automotive Equipment in Connection with Road Building and Maintenance"—T. Warren Allen, chief, division of control, U.S.D.A. Bureau of Public Roads

PAPER: "Design and Manufacturing Factors in Metalliferous Materials"—Ralph H. Sherry, consulting metallurgical and industrial engineer

PAPER: "Industrial Application of Tractors"—William Parrish, International Harvester Company

(One other paper to be scheduled on this program.)

The importance of research in the development of some of our leading manufacturing industries is generally recognized. The need of research in the development of the tractor industry is not less important than in any other that might be mentioned. The possibilities in this direction will be discussed by J. B. Davidson, professor of agricultural engineering at the Iowa State College, and will be based on his years of observation of and contact with the tractor industry and on a survey which he has recently completed for the U. S. Department of Agriculture. In his talk Prof. Davidson will have something of unusual interest to engineers concerned with the development of tractors and other farm machinery. Col. O. B. Zimmerman, experimental engineer of the International Harvester Company, recognized as one of the advanced thinkers in the industry on research, will discuss the subject of research from the standpoint of the tractor industry.

In arranging the program for the meeting a special effort has been made to schedule fewer subjects so that ample time will be available following the presentation of each paper for those who wish to discuss the subject and ask questions. The formal sessions will be confined to a period of two hours. This will provide considerable time before, after, and between sessions for those in attendance at the meeting to get acquainted with one another and have the opportunity for personal contact, which is one of the important objects of such meetings. Noonday luncheons and dinners specially arranged for those in attendance have been omitted; also no evening sessions have been scheduled. This has been done for the purpose of providing more time for those who attend the meeting to accomplish the things for which they came.

North Atlantic Section Meeting a Success

WHEN industries appreciate the value of the activities of a section of the American Society of Agricultural Engineers to the extent that they begin to bid for the privilege of having a section meeting held at a point where they may have the opportunity of acting as hosts, it is a distinct credit to the section. Such was the situation at the third meeting of the North Atlantic Section of the Society held at Pennsylvania State College, State College, Pennsylvania, October 11 and 12.

The meeting was a success in every sense of the word. Close to 50 per cent of the membership of the Section were in attendance, and it was also well attended by non-members of the Society connected with industries allied to agricultural engineering.

A feature of the program of the first day was a paper on some exceptionally interesting developments in farm building ventilation presented by F. L. Fairbanks, professor of rural engineering of the New York State College of Agriculture. This paper was discussed by Mr. Anderson, of the Ilg Electric Ventilating Company, who discussed some of the phases of mechanical ventilation.

A subject that stimulated considerable discussion was that of the requirements for farm building paint, the paper on the subject being presented by L. H. Trott, sales engineer of the New Jersey Zinc Sales Company.

Fruit storage is a problem of outstanding importance to which agricultural engineers are directing their attention. A paper by L. M. Marble, of the Marble Research Laboratory, of Canton, Pennsylvania, was one of the important contributions to the program.

The widespread interest among agricultural engineers in the results of the farm equipment research survey conducted during the past year by the division of agricultural engineering of the U. S. Department of Agriculture was recognized in the preparation of this program, and the report on the results of the survey was presented by S. H. McCrory, chief of the U.S.D.A. division of agricultural engineering. A progress report on the power and equipment research project under way at Pennsylvania State College was presented by H. B. Josephson, research engineer in charge of the project.

The entire afternoon session of October 12 was devoted to papers and discussions on rural electrification, the principal

paper of the session being that, entitled "Economic Aspects of Rural Electrification," presented by Dr. G. F. Warren, professor of agricultural economics of New York State College of Agriculture and one of the country's leading agricultural economists, which stimulated considerable discussion. The farmers' views on rural electrification were presented by Miles Horst, a Pennsylvania farmer. Reports on the rural electrification projects in Virginia and New Hampshire were presented by J. A. Waller, Jr., of the Virginia Polytechnic Institute, and W. T. Ackerman, project engineer of the New England rural electrification project, respectively.

An inspection tour of the Pennsylvania agricultural experiment station was a feature of the meeting which those in attendance found exceedingly interesting and profitable.

The evening of the first day, October 11, was devoted to several round-table discussions of particular interest to those in attendance, including farm buildings, agricultural engineering education, farm power, farm home utilities, and rural electrification.

A banquet and get-together meeting of A.S.A.E. members and guests, which proved a very fitting and enjoyable climax to the two days of technical sessions, was held the evening of October 12. A business meeting of the Section immediately followed the dinner. One of the actions taken at the business meeting of interest to the Society at large was a motion for a special committee to draft resolutions urging that the Council of the Society give consideration to the holding of the 1928 annual meeting of the Society at Washington, D. C.

The officers of the North Atlantic Section elected for the coming year at the business meeting are C. I. Gunness, professor of agricultural engineering at Massachusetts Agricultural College, chairman; R. W. Carpenter, professor of agricultural engineering at University of Maryland, vice-chairman; W. C. Harrington, Portland Cement Association, Syracuse, New York, secretary-treasurer.

At the invitation of representatives of the Westinghouse Electric & Manufacturing Company and the Sheet Steel Trade Extension Committee, the meeting voted to hold the 1927 meeting of the Section at Pittsburgh.

Southwest Section Holds First Meeting

AGRICULTURAL engineering made an appreciable advance in the states of the Southwest when the Southwest Section of the American Society of Agricultural Engineers met at the Hotel Adolphus, Dallas, Texas, on October 8. More than fifty per cent of the membership of the Society in the territory of the section was present at the meeting and the event was a success in every respect. The territory of the section comprises the states of Texas, Oklahoma, Arkansas, Louisiana, and New Mexico.

The outstanding feature of the meeting was the application of engineering to the production of the cotton crop. The first paper on the program dealt with studies in cotton machinery with special reference to cotton planting and was presented by H. P. Smith, associate professor of agricultural engineering at the Texas A. and M. College. Mr. Smith pointed out the necessity of depending on improved planting methods and seed selection to avoid the necessity of thinning by hand or machinery. He also discussed types of planters, amount of seed and how dropped, spacing, percentage of seed ruined, etc. His paper was illustrated by lantern slides.

Victor H. Schoffelmayer, agricultural editor of the Dallas "News," addressed the meeting on the subject of cotton growing contests, with special reference to machinery for profitable cotton production. Mr. Schoffelmayer stated that the greatest need of agriculture is the realization that we dare not produce inefficiently as much as we do. He pointed out that production costs of cotton range from 5 to 35 cents a pound and also that the average yield is decreasing, the present yield being around one hundred pounds per acre, whereas a few years ago it was around one hundred and fifty pounds per acre. He stated that, in his opinion, there is a need for a machine to plant two bushels of seed per acre, and the great waste of seed is more than offset by improved stand and final yield.

An address on recent developments in the application of electricity to agriculture was made by John W. Carpenter, vice-president and general manager of the Texas Power & Light Company, in which he pointed out that Texas is ready to begin the study of the application of electricity to agriculture and that in view of future development his company is now building 11,000-volt lines which serve small towns and individual farms adjacent to the line.

Charles M. Nevitt, sales manager of the Murray Gin Company, discussing the subject of cotton ginning machinery development, pointed out that gin ribs and saws remain practically unchanged, there having been no recent developments. He stated that cotton which used to be picked is now gathered, with the result that there is a great increase in the amount of trash received at the gin.

The effectiveness of machinery in the control of cotton insect pests was discussed by R. R. Reppert, entomologist at the A & M College of Texas, in which he called attention to the supreme importance of mechanical equipment for fighting cotton insect pests.

E. C. Koch, representing the American Engineering Council, spoke briefly on the study of waste in agriculture which that organization is outlining.

In the evening the Southwest Section of the Society and the Dallas Agricultural Club were guests at a dinner given by the Dallas Hardware and Implement Club. This dinner was featured by addresses by Frank A. Briggs, editor of "Farm and Ranch," on the farming conditions in the Southwest and by F. A. Wirt, past-president of the Society, on the use of machinery in the Southwest.

The nominating committee appointed by Chairman D. G. Carter has placed in nomination the following officers for the Southwest Section for the coming year: G. E. Martin, chairman; F. R. Jones, first vice-chairman; D. W. A. Bloodgood, second vice-chairman; H. P. Smith, secretary.

Engineering Development in Agriculture

(Continued from page 380)

The Society realizes that the farmer is entitled to live in the best kind of a home equipped with conveniences and modern appliances available to the city dweller. Through the activities of the Farm Structures Division effective work is being done is correlating the work of the various agencies engaged in the manufacture and sale of modern home appliances.

Plans are now under way to undertake a study of waste in the agricultural industry as affected by farm power and farm machinery. The American Society of Agricultural Engineers will have a very important part in this activity if it is undertaken. This would be a study similar in many respects to the study on wastes in industry which the American Engineering Council conducted in 1921.

Agricultural Engineering Education. I cannot let this opportunity pass without saying something of the educational work of the colleges as it affects your industry. The courses in agricultural engineering given at the various state colleges and universities are fitting men to become particularly qualified to enter upon careers within the farm equipment industry. In the courses required students are given training in engineering fundamentals and in agricultural subjects. This coupled with their practical farm experience gives them an agricultural viewpoint as well as an engineering training, qualifying them to cope with problems which confront the manufacturer of farm equipment in his development work.

Through the efforts of the joint Committee on Cooperative Relations of the American Society of Agricultural Engineers and the National Association of Farm Equipment Manufacturers, several of the manufacturers in the industry have instituted training courses into which these young agricultural engineering graduates are inducted and given a year's training under the direction of the factory's own representative and by the factory's own personnel. This training following their college studies has been found to work admirably in practically all cases. Such a plan has been in use by the electrical industry for many years with excellent results. We who are engaged in agricultural engineering educational work are pleased to see the farm equipment manufacturers adopting this method which has been used so

successfully for many years by other industries. We hope that more will avail themselves of the opportunities offered them through this means to secure highly trained men for their organizations. These young men, if they are to develop properly and become of the greatest value to the organizations in which they are placed, must be followed closely by the company officials or by someone designated to have charge of this training. It is only in this way that the plan will work successfully.

The application of engineering principles has had a great influence in the development of agriculture in the past and will become of more importance in the future. The various agencies and activities which depend upon agriculture for their existence and development must, therefore, make more use of the agricultural engineer if they are to make continued progress.

A Correction

ATTENTION is called to readers of AGRICULTURAL ENGINEERING of an error in the article, entitled "Strength of Lap Soldered Joints," by J. Grant Dent appearing on page 351 of the October issue. This error appears in the table accompanying the article—fourth line from the bottom. The tensile strength of copper (25 ga.) used in the test is given as 1230 pounds. It should have read "1330" pounds.

New A.S.A.E. Members

Herman H. Garner, president, Vortox Manufacturing Company, Pomona, Cal.

Samuel R. Gibbons, agricultural engineer, Alabama Power Company, Auburn, Ala.

George W. Kelley, editor, "Farmstead, Stock and Home," Minneapolis, Minn.

W. D. Hemker, general engineering, Westinghouse Electric & Mfg. Co., East Pittsburgh, Penn.

H. B. Josephson, research engineer, The Pennsylvania State College, State College, Penn.

W. A. Harper, sales promotional work, Hart-Parr Company, Charles City, Ia.

Gottlieb Muehleisen, president and general manager, National Soil Conservation Co., Alma, Wis.

R. L. Perry, instructor in agricultural engineering, Oregon Agricultural College, Corvallis, Ore.

Applicants for Membership

The following is a list of applicants for membership in the American Society of Agricultural Engineers received since the publication of the October issue of AGRICULTURAL ENGINEERING. Members of the Society are urged to send information relative to applicants for consideration of the Council prior to election.

W. C. Blackwood, professor of physics, Ontario Agricultural College, Guelph, Ontario, Canada.

F. L. Budgett, rural service division, Adirondack Power & Light Corporation, Schenectady, New York.

John Goddard, foreman, in charge of experimental work, Frost & Wood Co., Ltd., Smiths Falls, Ontario, Canada.

H. M. Harter, consulting agricultural engineer, Stockton, California.

W. H. Holmes, irrigation engineer, Modesto Irrigation District, Modesto, Cal.

Miles Horst, farmer-editor, Stockman-Farmer Publishing Company, Pittsburg, Penn.

Ethel G. Klopping, demonstrator of electric stoves, Municipal Electric Light and Power Plant, Richmond, Ind.

Alfred Krieg, chief engineer, Nichols & Shepard Co., Battle Creek, Mich.

Miriam Rapp, home economics department, Purdue University, Lafayette, Ind.

F. W. Small, field engineer, Portland Cement Association, Somerville, Mass.

Charles Volhert, contractor, farm water supply and well construction, South Manchester, Conn.

J. S. Witmer, assistant general sales manager, J. I. Case Threshing Machine Co., Racine, Wis.

Transfer of Grade

J. Grant Dent, instructor in agricultural engineering, University Farm, St. Paul, Minn.

A. D. Edgar, instructor in farm mechanics, Menominee Agricultural School, Menominee, Mich.

L. H. Ford, state tractor short-course instructor, State Department of Vocational Education, Greenfield, Ill.

W. J. Godtel, J. I. Case Threshing Machine Co., Racine, Wis.

Employment Bulletin

This service, conducted by the American Society of Agricultural Engineers, appears regularly in each issue of AGRICULTURAL ENGINEERING. Members of the Society in good standing will be listed in the published notices of the "Men Available" section. Non-members as well as members, are privileged to use the "Positions Open" section. Copy for notices should be in the Secretary's hands by the 20th of the month preceding date of issue. The form of notice should be such that the initial words indicate the classification. No charge will be made for this service.

Men Available

AGRICULTURAL ENGINEER, married, age 29, 1922 graduate of Iowa State College in agricultural engineering, now assistant engineer in construction department of International Railways of Central America, desires position where permanent residence is possible, preferably experimental or production work, or management of reclamation project or large ranch. Ten years experience in general farming with power equipment, experimental and teaching work, and construction work. Can speak Spanish, also some French and German. MA-130.

WORKS MANAGER available. Seventeen years experience in the designing and manufacture of tractors, harvesting machines, and earth-working tools. Sales experience in United States, Canada, England, France, and Italy. Write for interview. MA-132.

AGRICULTURAL ENGINEER, graduate of University of Illinois, nine years teaching experience as assistant professor in one of the largest universities of the central west. Eleven years manufacturing experience with one of the large tractor and farm implement builders. Experienced in production, design, and management. Desires position preferably as extension agricultural engineer or experimental or production manager work. MA-133.

AGRICULTURAL ENGINEER, single, age 26, graduate of University of Nebraska, College of Agriculture, with two years' practical experience in advertising and sales work, would like position in similar work preferably in South or Central America. Very good at drafting, designing, and photography of farm implements. Can speak a little Spanish. Has had a few articles published. Would submit samples of work. MA-134.

AGRICULTURAL ENGINEER, 1917 graduate Iowa State College, ten years' experience in highway; city; drainage; irrigation; concrete products; and concrete construction work. Available for immediate employment. MA-135.

AGRICULTURAL ENGINEER, 1926 graduate from Virginia Polytechnic Institute, desires position in some branch of agricultural engineering, preferably farm power and machinery. President of V.P.I. Student Branch of A.S.AE. in his senior year. MA-136.

Positions Open

AGRICULTURAL ENGINEER wanted to fill position at Preston, Cuba. Knowledge of Spanish desirable but not absolutely necessary. Farm experience, knowledge of gas and steam engines, and such machinery as ordinarily used on large sized farms is essential. Salary $150.00 to $175.00 per month, according to experience. Single man preferred. PO-116.

AGRICULTURAL ENGINEER wanted to divide his time between teaching and investigational work. He will handle instruction work in farm machinery and a research problem in rural electrification. The position to be filled by January 1927. Good salary for experienced man. Write C. E. Seitz, department of agricultural engineering, Virginia Polytechnic Institute, Blacksburg, Virginia.

DRAFTSMAN wanted by Midwest manufacturing concern with experience in planning dairy barns, hog and poultry houses. Write fully stating years of experience, previous employment, age, salary expected, and other details of interest. PO-118.

DESIGNING ENGINEER wanted by a large machinery manufacturer, contemplating the development of a combined harvester-thresher. A high-class designer with extensive experience is desired. PO-119.

AGRICULTURAL ENGINEER, a recent agricultural engineering graduate, wanted as draftsman and farm building designer by agricultural engineering department of one of the leading state colleges. Applicant must be a man who can develop into more responsible work and must have practical knowledge and an agricultural viewpoint on agricultural engineering problems. PO-120.